BeneView T5

Patient Monitor

Service Manual

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FOR YOUR NOTES

Preface

Manual Purpose

This manual provides detailed information about the assembling, dissembling, testing and troubleshooting of the equipment to support effective troubleshooting and repair. It is not intended to be a comprehensive, in-depth explanation of the product architecture or technical implementation. Observance of the manual is a prerequisite for proper equipment maintenance and prevents equipment damage and personnel injury.

This manual is based on the maximum configuration; Therefore, some contents may not apply to your monitor. If you have any question, please contact our Customer Service Department.

Intended Audience

This manual is for biomedical engineers, authorized technicians or service representatives responsible for troubleshooting, repairing and maintaining the patient monitors.

Revision History

This manual has a revision number. This revision number changes whenever the manual is updated due to software or technical specification change. Contents of this manual are subject to change without prior notice.

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Abbreviations

Abbreviations used in this manual are:

MPM	multi-parameter module
SMR	satellite module rack
CMS	central monitoring system

Passwords

A password may be required to access different modes within the monitor. The passwords are listed below:

- User maintenance: 888888
- Factory maintenance: 332888
- Demo mode: 2088

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1 Safety

1.1 Safety Information

⚠DANGER

- **Indicates an imminent hazard that, if not avoided, will result in death or serious injury.**

⚠WARNING

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.**

⚠CAUTION

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.**

NOTE

- **Provides application tips or other useful information to ensure that you get the most from your product.**

1.1.1 DANGER

There are no dangers that refer to the product in general. Specific “Danger” statements may be given in the respective sections of this manual.

1.1.2 Warnings

⚠WARNING

- **All installation operations, expansions, changes, modifications and repairs of this product are conducted by authorized personnel.**
- **There is high voltage inside the equipment. Never disassemble the equipment before it is disconnected from the AC power source.**
- **When you disassemble/reassemble a parameter module, a patient leakage current test must be performed before it is used again for monitoring.**
- **The equipment must be connected to a properly installed power outlet with protective earth contacts only. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on battery power, if possible.**
- **Dispose of the package material, observing the applicable waste control regulations and keeping it out of children’s reach.**

1.1.3 Cautions

⚠CAUTION

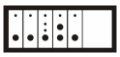
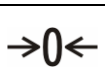
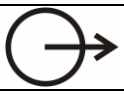
- **Make sure that no electromagnetic radiation interferes with the performance of the equipment when preparing to carry out performance tests. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Before connecting the equipment to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the equipment’s label or in this manual.**
- **Protect the equipment from damage caused by drop, impact, strong vibration or other mechanical force during servicing.**

1.1.4 Notes

NOTE

- **Refer to Operation Manual for detailed operation and other information.**

1.2 Equipment Symbols

	Attention: Consult accompanying documents (this manual).		CIS connector
	Danger: High-voltage		Network connector
	Alternating current(AC)		Defibrillator connector
	Power ON/OFF		Connector for satellite module rack
	Battery indication		Video output
	Zero key		Auxiliary output connector
	Calibrate key		USB connector
	Measure/Standby		Equipotential terminal
	Check sensor		ESD warning symbol for Electrostatic sensitive devices.
	Type CF applied part. Defibrillator-proof protection against electric shock.		
	Type BF applied part. Defibrillator-proof protection against electric shock.		

FOR YOUR NOTES

2 Theory of Operation

2.1 Introduction

This patient monitor is designed to monitor a fixed set of physiological parameters including ECG, heart rate (HR), respiration (Resp), temperature (Temp), SpO_2, pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2), anesthetic gas (AG), impedance cardiograph (ICG), bispectral index (BIS) and respiration mechanics (RM) of single adult, pediatric and neonatal patients

The patient monitor also:

- Provides audible and visual alarm indications in case of patient or equipment problems.
- Enables displaying, reviewing, storing and transferring of real-time data.
- Incorporates multiple input devices such as buttons, knob, touchscreen, keyboard and mouse.
- Interfaces a clinical information system or central monitoring system.
- Enables program upgrade over the network.

2.2 System Connections

2.2.1 Mounting the Patient Monitor

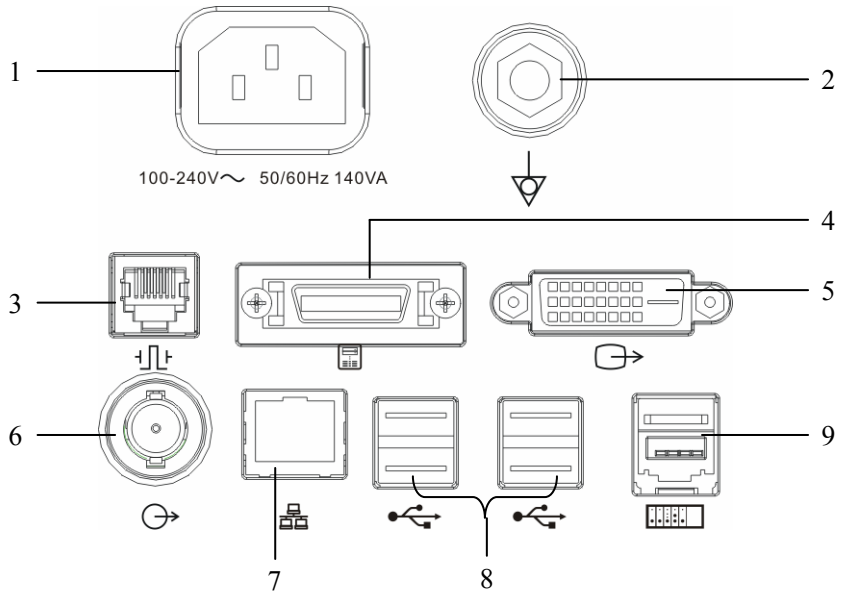
The patient monitor can be mounted on a wall bracket or on a trolley support. The wall bracket or trolley support can be ordered optionally. Each type of mounting bracket is delivered with a complete set of mounting hardware and instructions. Refer to the documentation delivered with the mounting hardware for instructions on assembling mounts.

⚠CAUTION

- **Use mounting brackets we supply or approve. If other compatible mounting bracket is used, be sure it can be safely used on the patient monitor.**
- **The mounting bracket should be installed by our qualified service personnel, or engineers who have adequate knowledge on it.**
- **If other mounting solution is used, the installation personnel and the customer should verify if it can be safely used on the patient monitor, and the customer assume the responsibility for any risk resulting from that.**

2.2.2 Connectors for Peripheral Devices

On the back of the patient monitor you will find all connectors for peripheral devices.



1. AC Power Connector: used to connect an AC power source (100 to 240 VAC, 50/60Hz).
2. Equipotential Terminal: used to connect the equipotential terminal of other equipment, eliminating potential difference between different pieces of equipment.
3. Defibrillator Connector: It is a RJ11 connector used to connect a defibrillator.
4. CIS Connector: It is a RJ45 connector used to connect a CIS and output 12V DC power supply.
5. Video Output: It is a DVI-D connector used to connect a secondary display.
6. Auxi Output Connector: It is a BNC connector used to output analog signals and nurse call signals.
7. Network Connector: It is a RJ45 connector used to connect an ethernet network or a PC.
8. USB Connector: used to connect any USB-compatible peripheral device.
9. SMR Connector: It is used to connect the SMR and outputs a 12V DC.

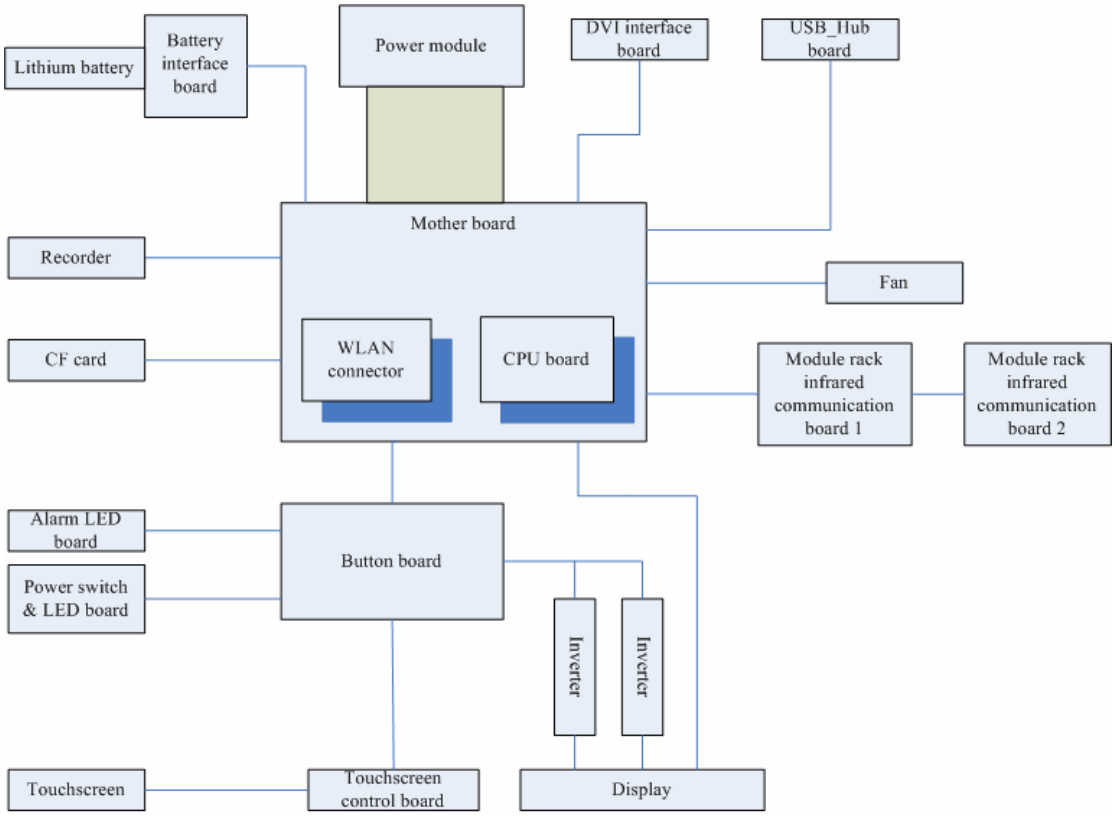
2.3 Main Unit

The patient monitor consists of:

- Input system: button board, knob, touchscreen, power switch and LED board
- Output system: LCD panel, alarm LED board, recorder and speaker
- Processing and communications system: main board and integral module rack assembly.
- Power management system: battery, battery interface board and power module
- Equipment interface system: USB_Hub interface board, DVI interface board and CF card assembly

Additionally, the patient monitor can also connect a satellite module rack (SMR), parameter modules, mouse, keyboard, etc.

The following diagram illustrates the structure of the patient monitor



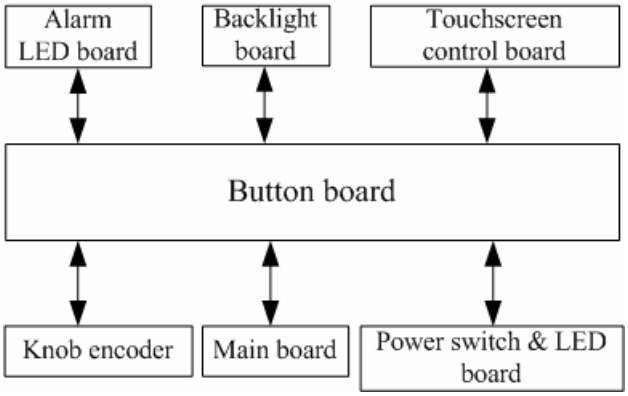
2.3.1 Input System

Button board

The button board, located at the lower part of the monitor's front panel, contains 6 keys and provides connections for the following components to the main board:

- Knob
- Power switch & LED board
- Touchscreen control board
- Alarm LED board
- Inverter

The following diagram shows the button board connections.



Knob

The knob can be pressed, or rotated both clockwise and counter-clockwise. It is connected with the button board.

Touchscreen

The touchscreen enables touch operations and can be calibrated. It is connected with the touchscreen control board and main board.

Power switch & LED Board

The power switch & LED board controls the power supply for the main unit. It has three LEDs, which respectively indicate the AC power status, battery status and monitor power on/off status. It is connected with the button board.

2.3.2 Output System

LCD panel

The patient monitor adopts a high-resolution LCD panel. The LCD panel is connected with the backlight board and the main board. It runs on power from a DC source, which originally comes from the main board, and then goes to the backlight board through the button board, and finally is delivered to the LCD panel by the backlight board.

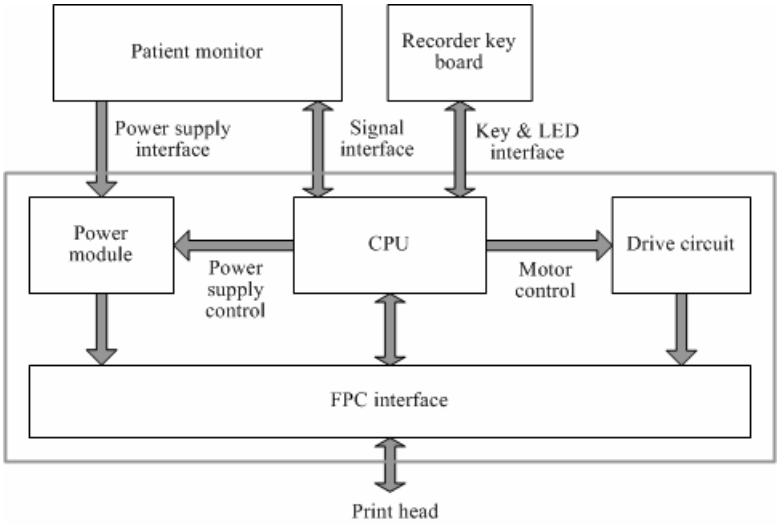
Alarm Lamp

The patient monitor has two alarm lamps: physiological alarm lamp and technical alarm lamp. The alarm LED board converts electric signals into visual signals and then sends the visual signals to the front panel through the light guiding post. Physiological alarm lamp lights either red or yellow whereas technical alarm lamp lights blue only.

Recorder

The recorder receives data form the main board and then sends them to the thermal printhead for printing. The recorder has a hardkey (starting/stopping recordings) and a green LED on its front panel. It is connected with the mother board.

The following diagram shows its operating principle.



Module	Description
Power interface	Introduces a DC from the main board.
Recorder power module	Converts the input power into voltages that fit each module and then forwards them to each module.

Recorder CPU	Controls the communications between modules.
Signal interface	Controls the communications between the main board and the recorder CPU.
Motor drive circuit	Receives the control signals from the CPU and then forwards them to the step motors
Button board & indicator interface	Sends key commands to the CPU and receive commands controlling the indicators from the CPU.
FPC interface	Sends the thermal printhead information to the CPU and receives the commands controlling the thermal printhead from the CPU.

Speaker

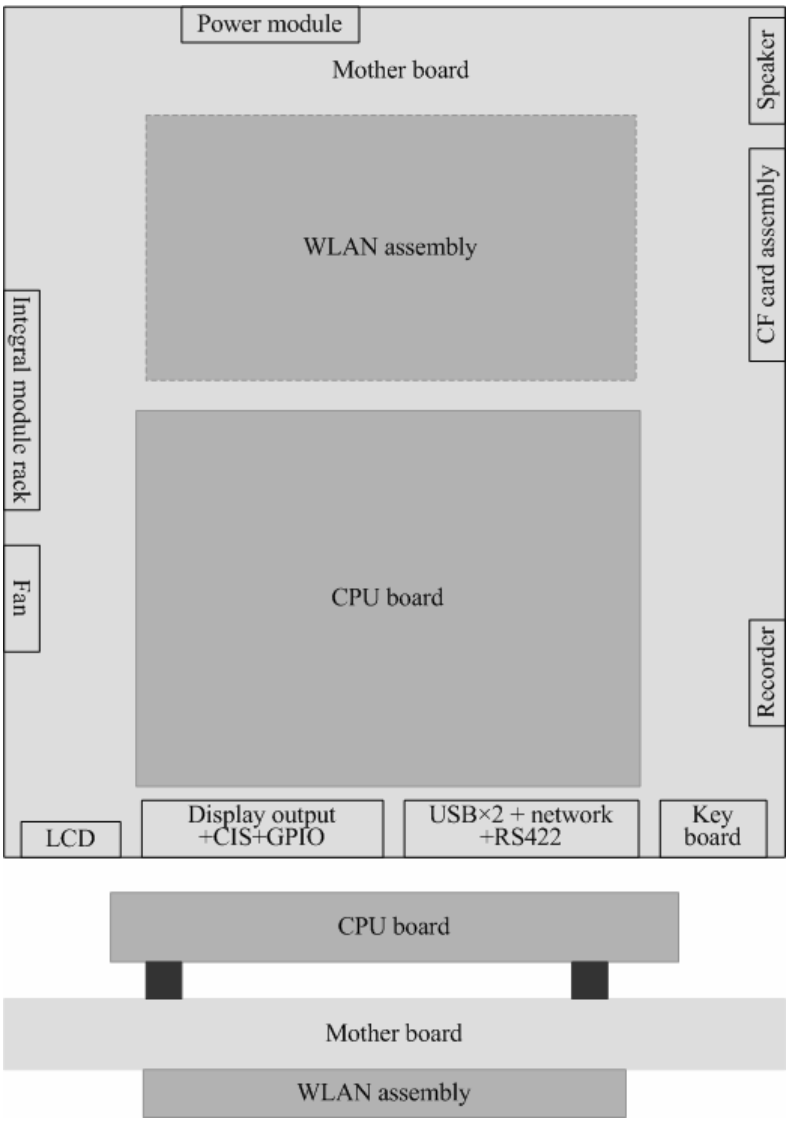
The speaker provides sound for alarms, key strokes, heart beats and pulse, and allows PITCH TONE and multi-level tone modulation. It is connected with the main board which provides sound signals.

2.3.3 Processing and Communications System

Main Board

The main board is the heart of the patient monitor. It implements a series of tasks including input & output control, data storage and processing, display processing, system control, communication management, printing management and alarming, etc.

The main board comprises the CPU board and mother board. The following diagram shows interfaces to other components.



The CPU board is an essential CPU system containing the CPU, FLASH, memory, realtime clock, EEPROM, etc. It interfaces to the mother board only, which then provides interfaces to all other external devices.

The mother board is in charge of connections and communications with other components and provides the following interfaces:

Name	Description
LCD connector	Connects the built-in display.
Video output +CIS+GPIO port	Connects the digital video interface board.
USB×2+network+RS422 port	Connects the USB_Hub board.
Button board connector	Connects the button board.
Recorder connector	Connects the recorder.
CF card connector	Connects the CF card assembly.
Speaker connector	Connects the speaker.
Power module connector	Connects the power module.
Integral module rack connector	Connects the 3-slot rack communication board in the integral module rack.
Fan connector	Connects the fan.
CPU board	It is connected with the mother board through a butt socket.
WLAN assembly	It is welded on the mother board.

Integral Module Rack

The patient monitor has two kinds of integral module rack: 2-slot and 5-slot. The integral module rack consists of control board and communication board.

The control board is a NIOS II module located on the communication board. It implements protocol conversion and infrared communication between the main unit and the parameter modules

The communication board can be a MPM type (2-slot type) or a 3-slot type. It consists of infrared circuit, RS422 communication circuit and power circuit. The communication board is connected with the mother board.

- The infrared circuit transmits and receives infrared signals, and controls signal intensity;
- RS422 communication circuit implements signal conversion between serial signals and RS422 signals;
- Power circuit transforms 12VDC power supply from the mother board into 3.3VDC power supply to run the module rack and provides 12VDC power supply to run the parameter modules.

2.3.4 Power Management System

Battery

The patient monitor uses two chargeable lithium-ion batteries (11.1 V, 4500 mAh). The battery compartment is located at the bottom of the patient monitor. The battery power is supplied to the mother board via the battery interface board, and then to the power module.

NOTE

- **AC mains must be used when the CIS is connected with the patient monitor.**

Battery Interface Board

The Battery interface board connects the batteries to the DC input terminal of the power module via the mother board, implementing charging and discharging of the batteries and the power board.

Power Module

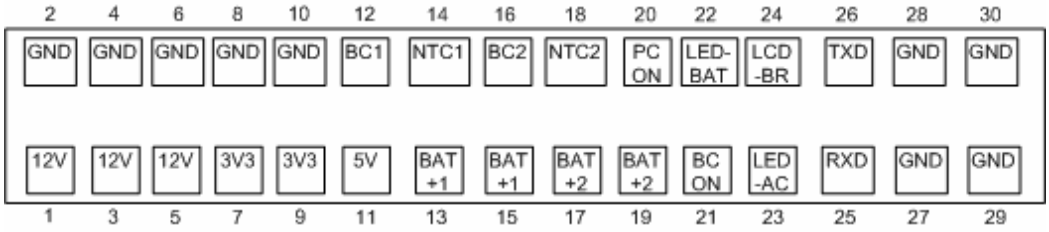
The power module is located at the back of the patient monitor. The main part of the power module is the power board, which contains charging & power management board, voltage drop DC transforming board and voltage rise and drop DC transforming board.

The power module converts the input power into DC power supplies and then distributes them to each component of the patient monitor. The input power comes from either the batteries or an AC source. The patient monitor will run power from the AC source whenever an AC source is available. If the AC source becomes unavailable, the patient monitor will automatically switch to the battery power. This does not affect the monitor's operating status.

The power module protects itself and the patient monitor by switching off AC input or DC output in case of overcurrent, short circuit and overvoltage. The power module provides 3 DC outputs:

Outputs	Description
＋3.3 V	Power supply of the mother board, CPU board, DVI interface board and integral module rack.
＋5.0 V	Power supply of the DVI interface board, recorder, CF storage card board and USB_Hub board.
＋12 V	Power supply of the recorder, LCD, integral module rack, parameter modules, USB_Hub board and the CIS

The following diagram shows the pins of the power socket connecting the power module and the mother board:


2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
GND GND GND GND GND BC1 NTC1 BC2 NTC2 PC ON LED- BAT LCD -BR TXD GND GND
12V 12V 12V 3V3 3V3 5V BAT +1 BAT +1 BAT +2 BAT +2 BC ON LED -AC RXD GND GND
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29

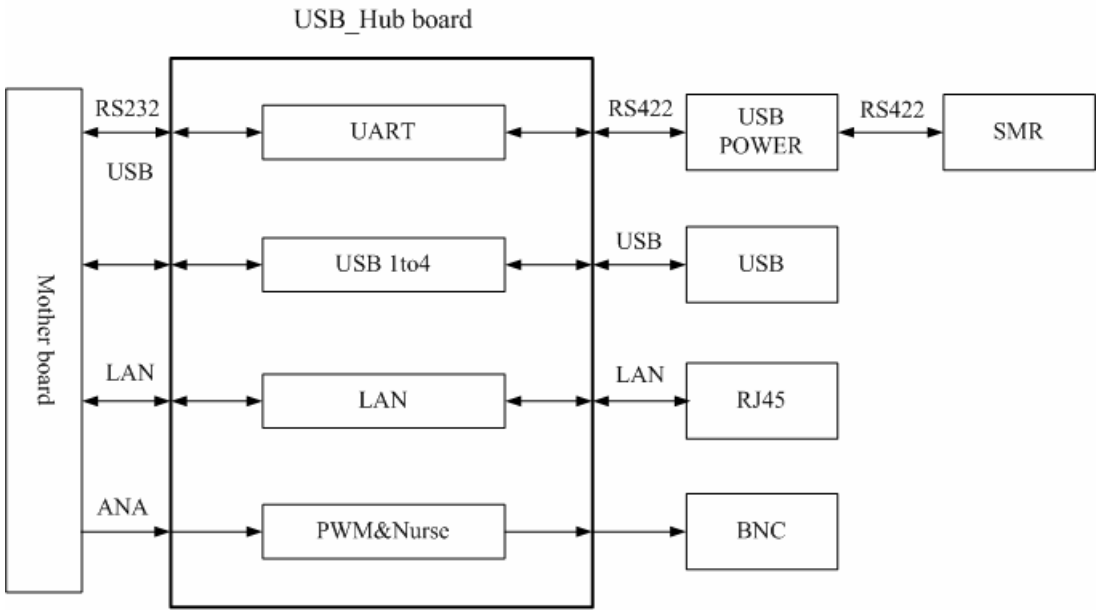
Pin ID	**Marking**	**Description**
1/3/5	12V	The positive output of the 12 VDC power
2/4/6/8/10/ 27/28/29/30	GND	The output grounding terminal of the power board.
7/9	3V3	The positive output of the 3.3 VDC power
11	5V	The positive output of the 5 VDC power
12	BC1	Signal indicating whether battery 1 is available. Low level indicates that battery 1 is available and high level indicates that battery 1 is not available.
13/15	BAT+1	Input of battery 1, connecting to the positive pole of the battery.
14	NTC1	Thermistor signal of battery 1.
16	BC2	Signal indicating whether battery 2 is available. Low level indicates that battery 2 is available and high level indicates that battery 2 is not available.
18	NTC2	Thermistor signal of battery 2.
17/19	BAT+2	Input of battery 2, connecting to the positive pole of the battery.
20	PCON	Power on/off control signal. It is a TTL pulse signal inputted from the back board. Every time when the power on/off switch is pressed (pulse of falling edge), a switch between power “on” and “off” happens. The pulse duration is no less than 0.1 s for power on, 2s for power off and 4s for illegal power off.
21	BCON	Backlight on/off signal and switch output signal. The main board sends the LCD backlight on/off signals to the power board via a serial port, the power board processes the signals and output

		them. Low level is output when the backlight is off and high level is output when the backlight is on.
22	LED-BAT	Battery status indication driving output
23	LED-AC	AC power status indication signal
24	LCD-BR	Backlight brightness control voltage.

2.3.5 Equipment Interface System

USB_Hub board

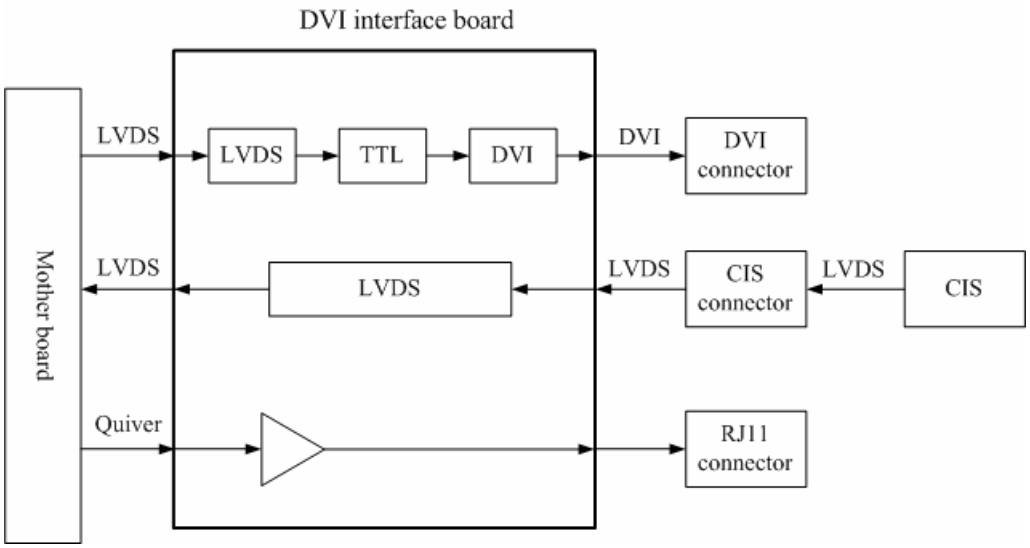
The USB_Hub board is connected with the mother board. It is compatible with USB1.1 connectors and supports equipment hot plug. Moreover, the USB_Hub board provides RS232 and RS422 interfaces for the communication between main board and SMR. It receives 5 VDC and 12 VDC inputs from the power module, of which the 5 VDC is supplied the USB interface board and the 12 VDC is outputted to the SMR connector through a fuse.



BNC	Connects analogue output and nurse call.
RJ 45 connector	It is a standard RJ45 connector, providing 10/100 BASE-TX Ethernet communications channels. It connects an Ethernet network or a PC.
USB connector	Connects devices with USB connector.
USB&POWER connector	Provides RS232 and RS422 interfaces for the communication between main board and SMR. It receives 5 VDC and 12 VDC inputs from the power module, of which the 5 VDC is supplied to the USB interface board and the 12 VDC is outputted to the SMR connector through a fuse.

DVI Interface Board

The DVI interface board is connected with the mother board. The following diagram shows its interfaces to other components.



Interface	Description
DVI connector	Connects the secondary display.
CIS Connector	Connects the CIS.
RJ 11 connector	Outputs defibrillator synchronization signals.

CF Card Assembly

The CF assembly serves the non-volatile CF card which is used for data storage and transferring. It is connected with the mother board.

2.4 Parameter Module

Each parameter module consists of the module communication board, module power board, module button board, parameter board, etc.

2.4.1 Module Communication Board

The module communication board allows a short delay when powering up the module and adopts FPGA to enable infrared communications between the module and the module rack. It has no electrical connections and is therefore isolated physically. It has an ID, which will be send to the module rack according to the pre-defined baud rate when a module is plug into the module rack.

2.4.2 Module Power Board

Some modules have no power board. There are two kinds of module power board:

1. Isolated power board: converts the 12 V DC into a 12 V isolated DC and a 5 V isolated DC.
2. Non-isolated power board: converts the 12 V DC into a 5 V DC

2.4.3 Module Button Board

There are keys and a LED on the module button board.

2.4.4 Parameter Board

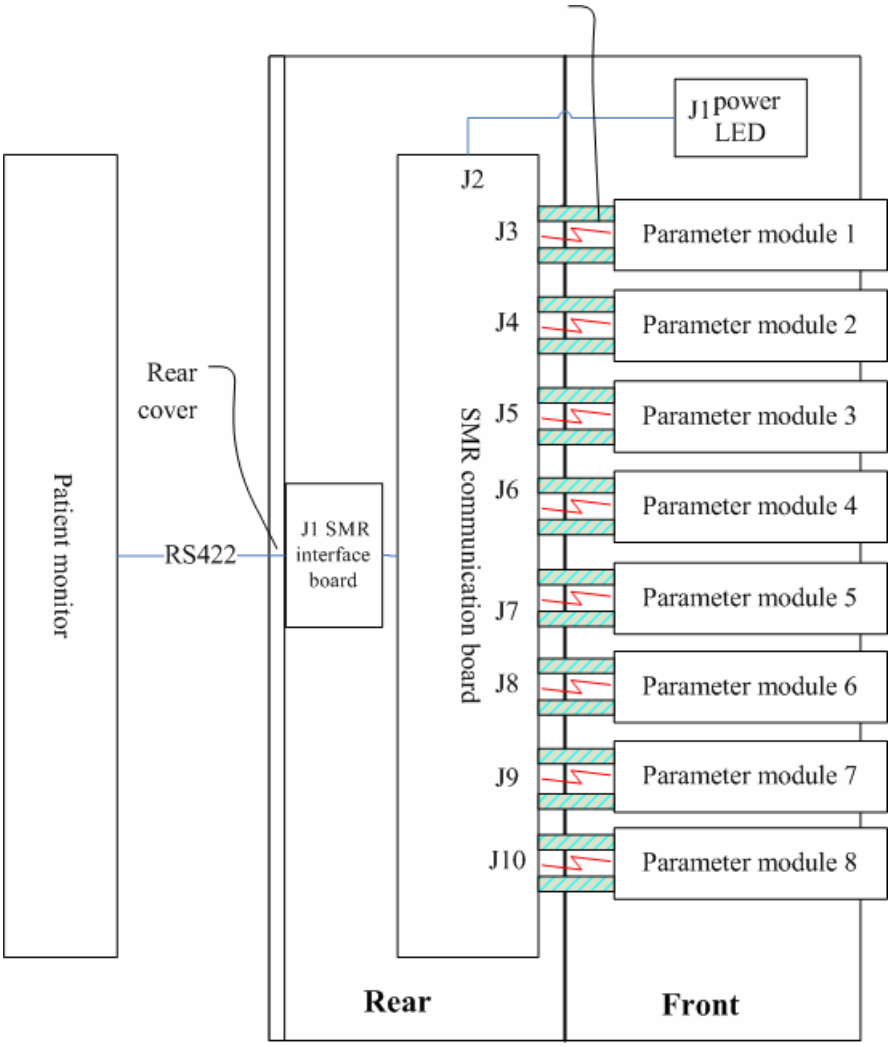
The parameter board is a parameter measurement component, which is the most important component of the parameter module.

2.5 SMR

The satellite module rack (SMR) is independent of the patient monitor. It provides 8 slots for mounting parameter modules. It has the following features:

- It allows a parameter module to be plugged and unplugged with the patient monitor on. This allows function extension and patient transfer.
- It does not have its own power supply. It is run by 12 V DC supplied by the patient monitor and then supplies power supply to each parameter module via the contact screws.
- It implements communication protocol conversions between the patient monitor and each parameter module, provides infrared communications for parameter modules, and is responsible for detecting infrared communications malfunction for each parameter module.

The following diagram shows the structure of the SMR.



3 Testing and Maintenance

3.1 Introduction

To ensure the patient monitor always functions normally, qualified service personnel should perform regular inspection, maintenance and test. This chapter provides a checklist of the testing procedures for the patient monitor with recommended test equipment and frequency. The service personnel should perform the testing and maintenance procedures as required and use appropriate test equipment.

The testing procedures provided in this chapter are intended to verify that the patient monitor meets the performance specifications. If the patient monitor or a module fails to perform as specified in any test, repairs or replacement must be done to correct the problem. If the problem persists, contact our Customer Service Department.

⚠CAUTION

- **All tests should be performed by qualified service personnel only.**
- **Care should be taken to change the settings in [User Maintenance] and [Factory Maintenance] menus to avoid loss of data.**
- **Service personnel should acquaint themselves with the test tools and make sure that test tools and cables are applicable.**

3.1.1 Test Report

After completing the tests, service personnel are required to record test results in this table and report them to our Customer Service Department.

Test Equipment			
Name		Model/PN	Expiry Date
Test Record			
No.	Test Item	Test Site	Test Results
1			
2			
Conclusion			
Pass/Fail:		Tested by:	Date:

3.1.2 Recommended Frequency

Check/Maintenance Item		**Frequency**
Visual test		1. When first installed or reinstalled.
Power on test		1. When first installed or reinstalled. 2. Following any maintenance or the replacement of any main unit parts.
Mainstream CO_2 test	/	1. If user suspects that the measurement is incorrect. 2. Following any repairs or replacement of respective module. 3. At least once every two years.
Sidestream and Microstream CO_2 tests	Leakage test	
	Calibration	
ECG tests	Performance test	
	Calibration	
Resp test	/	
NIBP tests	Accuracy test	
	Leakage test	
	Calibration	

IBP tests	Performance test	
	Pressure calibration	
SpO_2 test	/	
C.O. test	/	
Temp test	/	
BIS test	/	
RM test	/	
ICG test	/	
AG tests	Performance test	1. If user suspects that the measurement is incorrect. 2. Following any repairs or replacement of AG module. 3. At least once every year
	Calibration	
Nurse call relay performance test	/	If user suspects that the nurse call or analog output does not work well.
Analog output performance test	/	
Electrical safety tests	Enclosure leakage current test	1. Following any repair or replacement of the power module. 2. At least once every two years.
	Earth leakage current test	
	Patient leakage current test	
	Patient auxiliary current test	
Touchscreen calibration	/	1. When the touchscreen appears abnormal. 2. After the touchscreen is replaced.
Recorder check	/	Following any repair or replacement of the recorder.

3.2 Visual Test

Inspect the equipment for obvious signs of damage. The test is passed if the equipment has no obvious signs of damage. Follow these guidelines when inspecting the equipment:

- Carefully inspect the case, the display screen and the buttons for physical damage to
- Inspect the SMR and parameter modules for mechanical damage.
- Inspect all external connections for loose connectors, bent pins or frayed cables.
- Inspect all connectors on the equipment for loose connectors or bent pins.
- Make sure that safety labels and data plates on the equipment are clearly legible.

3.3 Power On Test

This test is to verify that the patient monitor can power up correctly. The test is passed if the patient monitor starts up by following this procedure:

1. Insert two batteries in the battery chamber and connect the patient monitor to the AC mains, the AC mains LED and battery LED light.
2. Press the power on/off switch to switch on the patient monitor. The operating status LED lights up, and the technical and physiological alarm lamps light blue and red respectively.
3. After the start-up screens are displayed, the system sounds a beep indicating the self test on alarm sounds is passed. At the same time, the technical alarm lamp turns yellow, and then turns off together with the physiological alarm lamp. This indicates that the self test on alarm lamps is passed.
4. The patient monitor enters the main screen and start-up is finished.

3.4 Module Performance Tests

3.4.1 Mainstream CO_2 Tests

Follow this procedure to perform the test:

1. Connect the mainstream CO_2 module with the sensor and plug the module in the module rack.
2. Enter the [**CO2 Setup**] menu to set [**Operating Mode**] to [**Measure**]. Wait for CO_2 module warmup.
3. Select [**Start Zero Cal.**] in the [**CO2 Setup**] menu. If zero calibration fails, the prompt information [**CO2 Zero Failed**] is displayed. If it passes, the baseline of waveform returns to zero.
4. Set [**Apnea Time]** to 10 s in the [**Adjust CO2 Limits**] menu.
5. Blow to the CO_2 sensor to generate a CO_2 waveform. Hold the sensor for 10 s and the alarm message [**CO2 Apnea]** is displayed on the screen.
6. Disconnect the CO_2 sensor, verify that prompt information [**CO2 Comm Stop**] is displayed.

3.4.2 Sidestream and Microstream CO_2 Module Test

Leakage test

Follow this procedure to perform the test:

1. Plug the module in the module rack.
2. Enter the [**CO2 Setup**] menu to set [**Operating Mode**] to [**Measure**]. Wait for CO_2 module warmup.
3. Block the gas inlet completely.
   - Sidestream: Check that alarm message [**CO2 FilterLine Err**] is displayed on the screen in 3s. Block the gas inlet for another 30s, if the alarm message does not disappear, the module does not leak.
   - Microstream: Check that alarm message [**CO2 Purging**] is displayed on the screen in 3s. Block the gas inlet for another 30s, if alarm message [**CO2 FilterLine Err**] is shown, the module does not leak.

Calibration

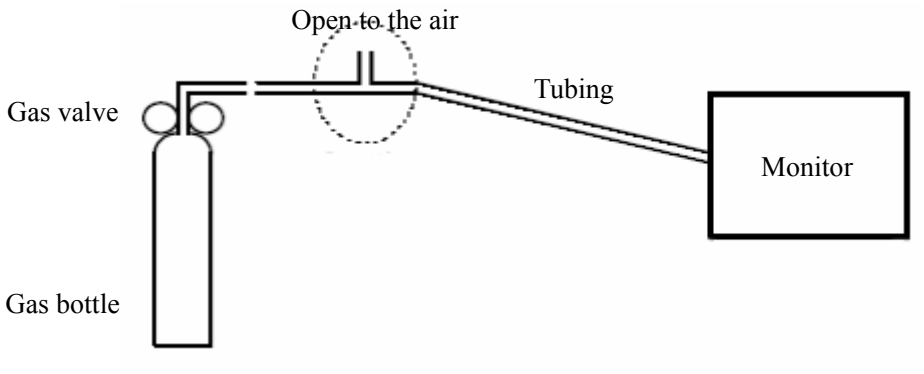
Tools required:

- A gas bottle with 5% CO_2 gas
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Make sure that the CO_2 module has been warmed up or started up.
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance** >>]→enter the required password→[**Maintain CO2 >>**].
3. In the [**Maintain CO2**] menu, select [**Zero**].

4. Connect the gas bottle with the tubing using a T-shape connector as shown below. Check the airway and make sure there are no leaks.



5. Vent the tubing to the CO_2 opening the gas valve.
6. In the [**Calibrate CO2**] menu, enter the vented CO_2 concentration in the [**CO2**] field.
7. In the [**Maintain CO2**] menu, the measured CO_2 concentration, barometric pressure, sensor temperature and current flowrate are displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate CO2**] to calibrate the CO_2 module.
8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.

3.4.3 ECG Tests

ECG Performance Test

Tool required:

- Patient simulator

1. Connect the patient simulator to the ECG/Resp connector on the module.
2. Set HR output to 80 bpm in the ECG simulator.
3. The displayed HR value should be 80 ± 1 bpm for 3- and 5-lead ECG monitoring, 80 ± 2 bpm for 12-lead ECG monitoring.

ECG Calibration

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module.

1. Select the ECG parameter window or waveform area→[**Filter**]→[**Diagnostic**].
2. Select [**Main Menu**]→[**Maintenance>>**].
3. Select [**Calibrate ECG**]. A square wave appears on the screen and the message [**ECG Calibrating**] is displayed.
4. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%. You can also print out the square wave and the wave scale if necessary.

3.4.4 Resp Performance Test

Tool required:

- Patient simulator

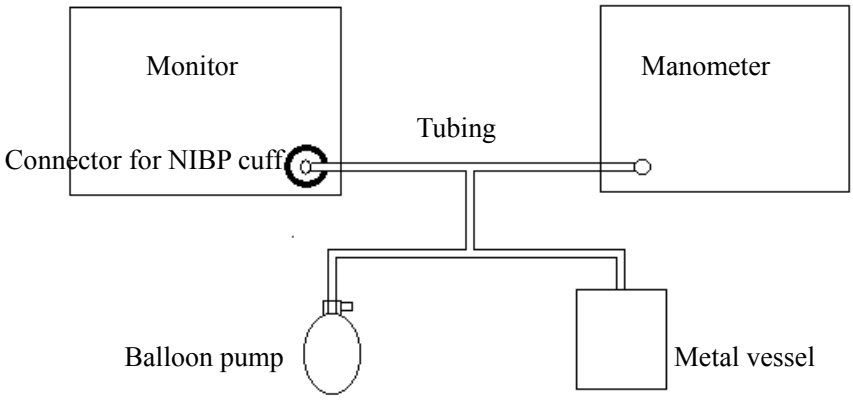
1. Connect the patient simulator to the Resp connector on the module.
2. Configure the simulator as follows: base impedance line 1500 Ω; delta impedance 0.5 Ω, respiration rate 40 rpm.
3. The displayed Resp value should be 40 ± 2 rpm.

3.4.5 NIBP Tests

NIBP Accuracy Test

Tools required:

- T-shape connector
- Approprating tubing
- Balloon pump
- Metal Vessel with volume 500 ± 25 ml
- Reference manometer with accuracy 1 mmHg



Follow this procedure to perform the test:

1. Connect the equipment as shown above.
2. Before inflation, the reading of the manometer should be 0. If not, disconnect the airway and reconnect it unit the readings is 0.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**NIBP Accuracy Test**].
4. Compare the manometer values with the displayed values. The difference between the manometer and displayed values should be no greater than 3 mmHg.
5. Raise the pressure in the metal vessel to 50 mmHg with the balloon pump. Repeat step 3 and 4.
6. Raise the pressure in the metal vessel to 200 mmHg with the balloon pump. Repeat step 3 and 4.

NOTE

- **You can use an NIBP simulator to replace the balloon pump and the reference manometer to perform the test.**

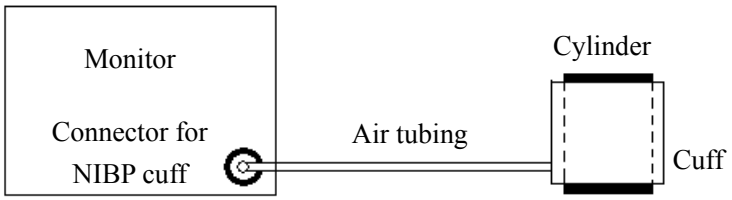
NIBP Leakage Test

Tools required:

- NIBP cuff for adult patient
- Approprating tubing
- Cylinder

Follow this procedure to perform the test:

1. Set [**Patient Category**] to [**Adult**].
2. Connect the NIBP cuff with the NIBP connector on the moduel.
3. Apply the cuff to the cylinder as shown below.
4. Select [**Main Menu**]→[**Maintenance>>**]→[**NIBP Leakage Test**]. The message [**Leakage Testing…**] is displayed in the NIBP parameter area.
5. The cuff automatically deflates in 20s which means NIBP leakage test is completed.
6. If the system does not leak, no message is displayed in the NIBP parameter area. If it leaks, the message [**NIBP Pneumatic Leak**] is displayed. In this case, check for loose connection and perform the test again.



NIBP Calibration

Tools required:

- T-shape connector
- Approprating tubing
- Balloon pump
- Metal Vessel with volume 500 ± 25 ml
- Reference manometer with accuracy 1 mmHg

1. Connect the equipment as shown below.
2. Before inflation, the reading of the manometer should be 0. If not, disconnect the airway and reconnect it unit the readings is 0.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**Factory Maintenance >>**]→enter the required password→[**Calibrate NIBP >>**].
4. Set [**NIBP Pressure**] to 150 mmHg in the [**NIBP measurement circuit**]. Raise the pump output to 150 mmHg. After the pressure value is stabilized, select the [**Calibrate**] button to start the calibration.
5. Set patient category to [**Adu/Ped**] in the [**overpressure protection circuit**], raise the pressure to 330 mmHg. Then, select [**Calibrate**] to start the calibration.
6. Set the patient category to [**Neo**] in the [**overpressure protection circuit**], raise the pressure to 165 mmHg. Then, select [**Calibrate**] to start the calibration.
7. Calibration result is displayed in the [**Calibrate NIBP**] menu. If calibration fails, Check the system connection and perform calibration test again.

3.4.6 IBP Tests

IBP Performance Test

Tool required:

- Patient simulator

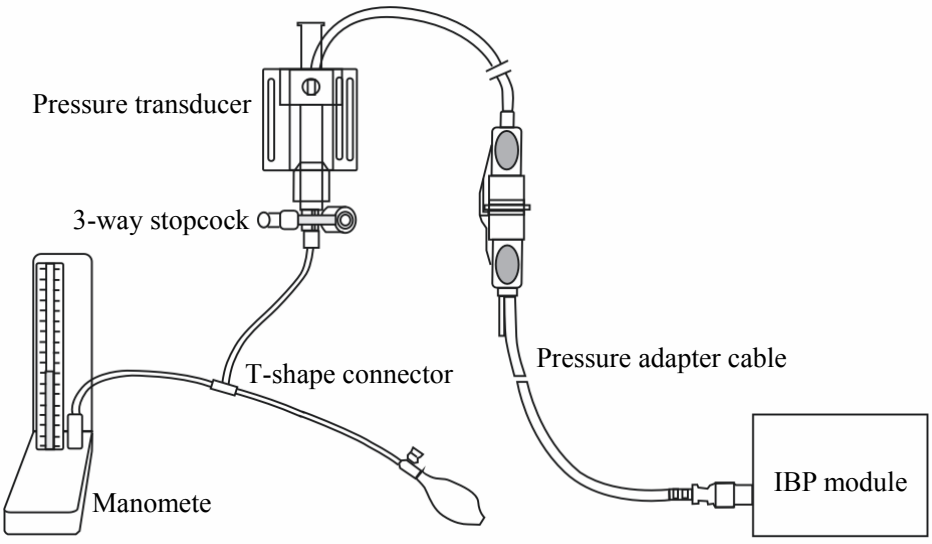
1. Connect the patient simulator to the pressure connector on the module.
2. Set the pressure value of patient simulator to 0.
3. Press the Zero Key on the module to start a zero calibration.
4. Configure the patient simulator as P(static)=200 mmHg.
5. The displayed value should be 200 ± 2 mmHg.
6. If the value is beyond tolerance, calibrate the pressure module.

IBP Pressure Calibration

Tools required:

- Standard sphygmomanometer
- Balloon pump
- Tubing
- T-shape connector

1. Connect the equipment as shown below



2. Zero the transducer. After a successful zero, open the stopcock to the manometer.
3. Select [**Main Menu**]→[**Maintenance** >>]→[**Cal**. **IBP Press.** >>]. In the [**Cal. IBP Press.**] menu, enter calibration values for calibrated pressures.
4. Inflate using the balloon pump until the mercury in the manometer reaches to the preset calibration pressure value.
5. Adjust the preset calibration value until it equals to the reading on the manometer.
6. Select the [**Calibrate**] button to the right of the calibrated pressure. The monitor starts a calibration.
7. If the calibration is completed successfully, the message [**Calibration Completed!**] will be displayed. If not, respective message will be displayed.

3.4.7 SpO_2 Test

Tool Required: Patient simulator.

1. Connect the patient simulator to the SpO_2 connector on the MPM.
2. Select the model and the manufacturer of the SpO_2 module under test, and then configure the patient simulator as follows: SpO_2 96%; PR 80 bpm.
3. The displayed SpO_2 and PR values should be within the ranges listed below.

		SpO_2	PR (bpm)
MPM SpO_2 Module		96% ± 2%	80 ± 3
Masimo SpO_2 Module		96% ± 2%	80 ± 3
Nellcor SpO_2 Module	MAX-A, MAX-AL, MAX-N, MAX-P, MAX-I, MAX-FAST	96% ± 2%	80 ± 3
	OxiCliq A, OxiCliq N, OxiCliq P, OxiCliq I	96% ± 2.5%	
	D-YS, DS-100A, OXI-A/N, OXI-P/I	96% ± 3%	
	MAX-R, D-YSE, D-YSPD	96% ± 3.5%	

3.4.8 C.O. Test

Tool required: Patient simulator

1. Connect the patient simulator to the C.O. connector on the module.
2. Set the patient simulator to output blood temperature (BT) 37° C. The displayed temperature value should be 37 ± 0.1° C.

3.4.9 Temp Test

Tool required: Resistance box

1. Connect the two pins of any Temp connector on the module to the two ends of the resistance box using 2 wires.
2. Set the resistance box to 1354.9 Ω (corresponding temperature is 37° C). The displayed value should be 37 ± 0.2° C.

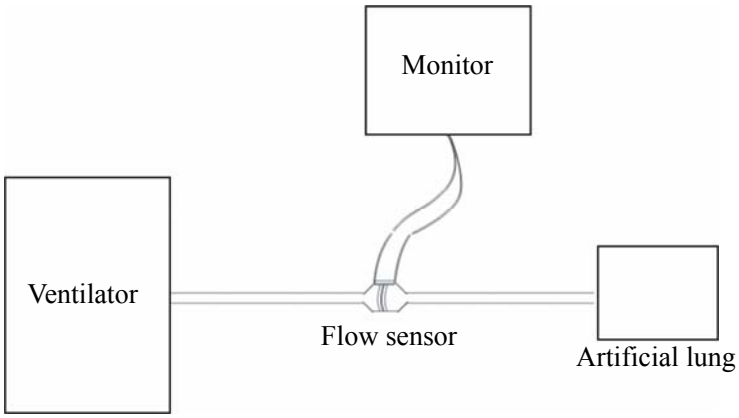
3.4.10 BIS Test

1. Connect the BIS sensor with a normal and wide awake person as directed in the Operation Manual.
2. The displayed BIS value should be higher than 80.

3.4.11 RM Test

Tool required:

- Gas source
- Ventilator (calibrated)
- Artificial lung
- Flow sensor



Follow this procedure to check the performance of RM module:

1. Connect the equipment as shown above. Make sure that the blue sensing tube on the flow sensor is connected with the artificial lung.
2. Set [**Patient Category**] to [**Adult**]. Enter [**RM Setup**] menu to select [**Sensor Type**] and set [**Ventilation Mode**] to [**Mechanical**].
3. Calibrate the flow sensor.
4. Configure the ventilator or anesthetic machine as follows: TV 500 ml, respiration rate =20 rpm, I:E=1:2.
5. Select [**Respiratory Loop**] in the [**RM Setup**] menu. Verify that displayed value meets product specification.

3.4.12 ICG Test

Tool required: Patient simulator

1. Connect the patient simulator, ICG sensor and the patient monitor using standard ICG cable.
2. Select **[ICG setup]**→[**Patient Demographics** >>]→ input parameter values as follows:

Height	173 cm	CVP	6 mmHg
Weight	75 kg	PAmean	8 mmHg
LV_D	50 mm	Art Mean	93 mmHg
PAWP	10 mmHg		

3. Switch the patient simulator to Mode 1 and then start ICG measurements.
4. After the measurement becomes stable, document the measured values.
5. Switch the patient simulator to mode 2 and then start ICG measurements. After the measurement becomes stable, document the measured values.
6. Check that measured values meet the simulator configuration

3.4.13 AG Tests

AG Performance Test

Tool required:

- Gas bottle with a certain standard anesthetic gas. Gas concentration should meet AA>1.5%, of which AA represents an anesthetic agent
- T-shape connector
- Tubing

1. Plug the AG module in the module rack. Enter [**AG Setup**] menu and set [**Operating Mode**] to [**Measure**].
2. After the AG module warmup is ready, block the gas inlet of the AG module. Alarm message [AC Airway Occluded] is displayed.
3. Connect the equipment as shown below.
4. Open and close the gas valve repeatedly at an interval of 3 seconds. The AA value displayed should meet product specification.

BIS Performance Test

The AG module can incorporates the features of the BIS module, refer to ***3.4.10 BIS Test*** for test procedures.

O_2 Performance Test

Tool required:

- Gas bottle with 100% O_2
- T-shape connector
- Tubing

The AG module can incorporates the features of the O_2 module, refer to ***AG Performance Test*** above for test procedures.

AG Calibration

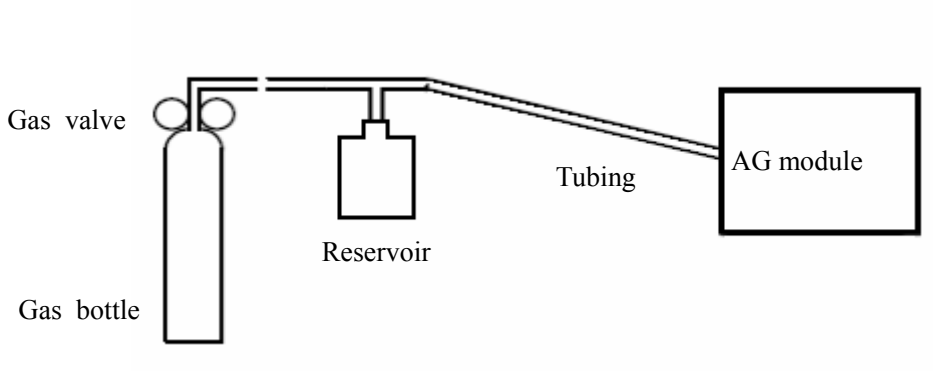
Tools required:

- Gas bottle, with a certain standard gas or mixture gas. Gas concentration should meet the following requirements: AA>1.5%, CO_2>1.5%, N_2O>40%, O_2>40%, of which AA represents an anesthetic agent.
- T-shape connector
- Tubing
- Reservoir bag

Follow this procedure to perform the calibration:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance** >>]→enter the required password→[**Calibrate AG >>**].
2. Check the airway and make sure that there are no occlusions or leaks.
   - ◆ Vent the sampling tubing to the air and check if the [**Current FlowRate**] and [**Set FlowRate**] are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.
   - ◆ Block the gas inlet of the tubing. The [**Current FlowRate**] shall fall rapidly and the system prompt that the tubing is blocked. Otherwise, it indicates that there are leakages in the tubing. Check the tubing for leakages.

3. Connect the gas bottle, reservoir bag and the tubing using a T-shape connector as shown in the figure below.



4. Open the gas valve and vent a certain standard gas or mixture gas.
5. In the [**Calibrate AG**] menu, the concentration and flowrate of each measured gas are displayed.
   - If the difference between the measured gas concentration and the actual one is tolerable, a calibration is not needed.
   - If the difference is great, a calibration should be performed. Select [**Calibrate >>**] to enter the calibrate menu.
6. Enter the vented gas concentration. If you use only one gas for calibration, set other gases' concentration to 0.
7. Select [**Start**] to start calibration.
8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.

3.5 Nurse Call Relay Performance Test

Tools required:

- Multimeter

1. Connect the nurse call cable to the Auxiliary Output Connector of the patient monitor.
2. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password→[**Others** >>]→[**Auxiliary Output**]→[**Nurse Call].** Enter Demo mode.
3. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password→[**Others** >>]→[**Nurse Call Setup** >>]. Enable all alarm level and alarm type options. Set **[Contact Type]** to **[Normally Open]**
4. In [**Nurse Call Setup** >>] setup menu, set [**Signal Type**] to [**Pulse**]. Trigger an alarm and measure the output contact with the multimeter. The output should be square waves with an interval of 1s.
5. In [**Nurse Call Setup** >>] setup menu, set [**Signal Type**] to [**Continuous**]. Trigger an alarm and measure the contact output with the multimeter. The output should be continuous high level.

3.6 Analog Output Performance Test

Tool required:

- Oscillograph

1. Connect the oscillograph to the Auxiliary Output Connector of the patient monitor.
2. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password→[**Others** >>]→[**Auxiliary Output**]→[**Analog Output].** Enter Demo mode.
3. Select [**Main Menu**] →[**Analog Output Setup].** Switch Analog Output [On], and then test the ECG and IBP signals from the Analog Output Connector.
4. The waveforms displayed on the oscillograph should closely resemble those displayed on the patient monitor.

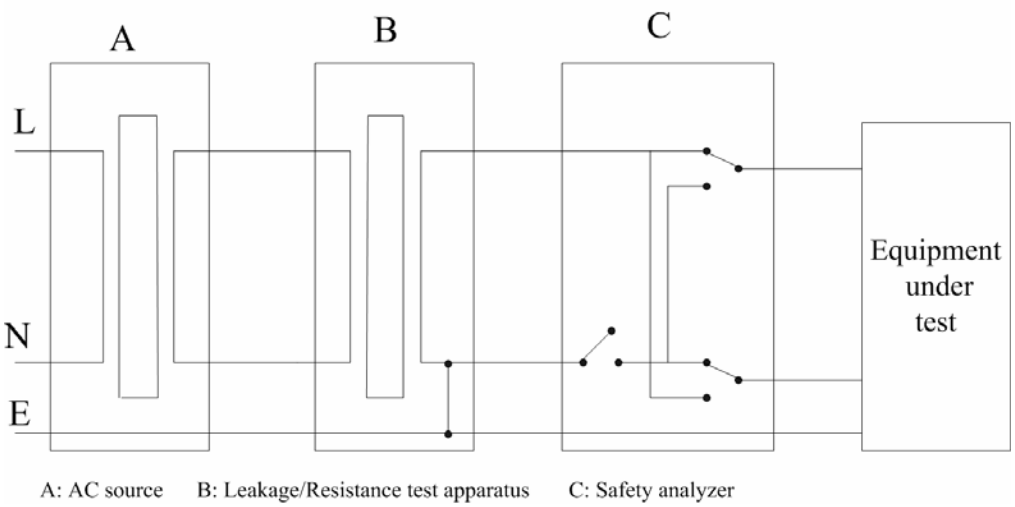
3.7 Electrical Safety Tests

⚠WARNING

- **Electrical safety tests are a proven means of verifying the electrical safety of the patient monitor. They are intended for determining potential electrical hazards. Failure to find out these hazards timely may cause personnel injury.**
- **Commercially available test equipment such as safety analyzer, etc. can be used for electrical safety tests. Be sure that the test equipment can be safely and reliably used with the patient monitor before use. The service personnel should acquaint themselves with the use of the test equipment.**
- **Electrical safety tests should meet the requirements of the new edition of standards EN 60601-1 and UL60601.**
- **These electrical safety tests do not supersede local requirements.**
- **All devices using the AC mains and connected to medical equipment within patient environments must meet the requirements of the IEC 60601-1 medical electrical systems standard and should be put under electrical safety tests at the frequency recommended for the patient monitor.**

Electrical safety tests are intended to check if potential electrical hazards to the patient, operator or service personnel of the equipment. Electrical safety test should be performed under normal ambient conditions of temperature, humidity and pressure.
The electrical safety test plan described hereafter takes 601 safety analyzer as an example. Different safety analyzers may be used in different areas. Be sure to choose applicable test plan.

Connection of the equipment is shown below:



Tools required:

- Safety analyzer
- Isolation transformer

3.7.1 Enclosure Leakage Current Test

1. Connect the 601 safety analyzer to an AC power supply (264 V, 60 Hz).
2. Connect SUM terminal of the applied part connection apparatus to RA input terminal of 601 safety analyzer, another terminal to the applied part of EUT.
3. Connect the EUT to the analyzer's auxiliary output connector using a power cord.
4. Attach one end of the red lead to the "Red input terminal" of the analyzer, and the other end to tinsel over the enclosure of the EUT.
5. Power on the 601 safety analyzer and then press the "5－Enclosure leakage" button on the analyzer's panel to enter the enclosure leakage test screen.
6. Under normal condition, the enclosure leakage current should be no greater than 100 μA. Under single fault condition, it should be no greater than 300 μA.

3.7.2 Earth Leakage Current Test

1. Connect the 601 safety analyzer to an AC power supply (264 V, 60 Hz).
2. Connect SUM terminal of the applied part connection apparatus to RA input terminal of 601 safety analyzer, another terminal to the applied part of EUT.
3. Connect the EUT to the analyzer's auxiliary output connector using a power cord.
4. Power on the 601 safety analyzer and then press the "4－Earth leakage" button on the analyzer's panel to enter the earth leakage test screen.
5. Under normal condition, the earth leakage current should be no greater than 300 μA. Under single fault condition, it should be no greater than 1000 μA.

3.7.3 Patient Leakage Current Test

1. Connect the 601 safety analyzer to an AC power supply (264 V, 60 Hz).
2. Connect SUM terminal of the applied part connection apparatus to RA input terminal of 601 safety analyzer, another terminal to the applied part of EUT.
3. Connect the EUT to the analyzer's auxiliary output connector using a power cord.
4. Power on the 601 safety analyzer and then press the "6－Patient leakage" button on the analyzer's panel to enter the Patient leakage test screen.
5. Repeatedly press the "Applied Part"button to measure AC and DC leakage alternatively. DC leakage reading is following by "DC".
6. Under normal status, the patient leakage current should be no greater than 10 μA. Under single fault condition, it should be no greater than 50 μA.

3.7.4 Patient Auxiliary Leakage Current Test

1. Connect the 601 safety analyzer to an AC source (264 V, 60 Hz).
2. Connect the equipment under test (EUT) to the analyzer's auxiliary output connector using a power cord.
3. Connect the sensors of the applied part to the applied part connection apparatus, whose RA-P terminal is connected to 601 safety analyzer's RA terminal (which is turned on) and SUM terminal to 601 safety analyzer's LA terminal. RA terminal is switched to on.
4. Power on the 601 safety analyzer and then press the "8－Patient Auxiliary Current Test" button on the analyzer's panel to enter the patient auxiliary current test screen.
5. Repeatedly press the "Applied Part"button to measure AC and DC leakage alternatively. DC leakage reading is following by "DC".
6. Under normal status, the patient auxiliary leakage current should be no greater than 10 μA. Under single fault condition, it should be no greater than 50 μA.

3.8 Touchscreen Calibration

1. Select the [**Cal. Screen**] QuickKey or select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Cal. Touchscreen**].
2. The symbol will appear at different positions of the screen.
3. Select, in turn, the central point of the symbol.
4. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

3.9 Recorder Check

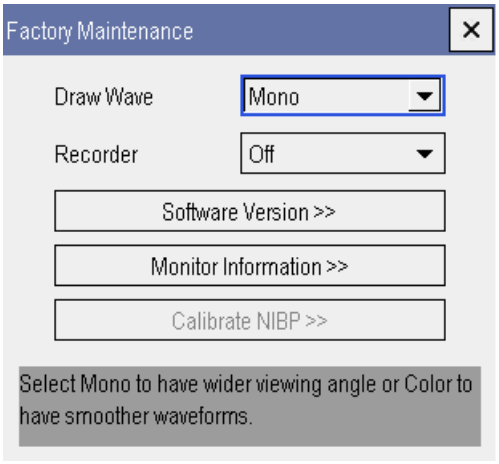
1. Print ECG waveforms. The recorder should print correctly and printout should be clear.
2. Set the recorder to some problems such as out of paper, paper jam, etc. the patient monitor should give corresponding prompt messages. After the problem is removed, the recorder should be able to work correctly.
3. Switch automatic alarm recording for each parameter ON and then set each parameter's limit outside set alarm limits. Corresponding alarm recordings should be triggered when parameter alarms occur.

3.10 Factory Maintenance

3.10.1 Accessing Factory Maintenance Menu

To access the factory maintenance menu, select [**Main Menu**]→[**Maintenance >>**] → [**Factory Maintenance**]and then enter the required password.

The [**Factory Maintenance**] menu is shown below.



3.10.2 Drawing Waves

There are two methods to draw waves: Color and Mono.

- Color: selecting Color will have smoother waveforms.
- Mono: selecting Mono will have a wider viewing angle.

3.10.3 Recorder

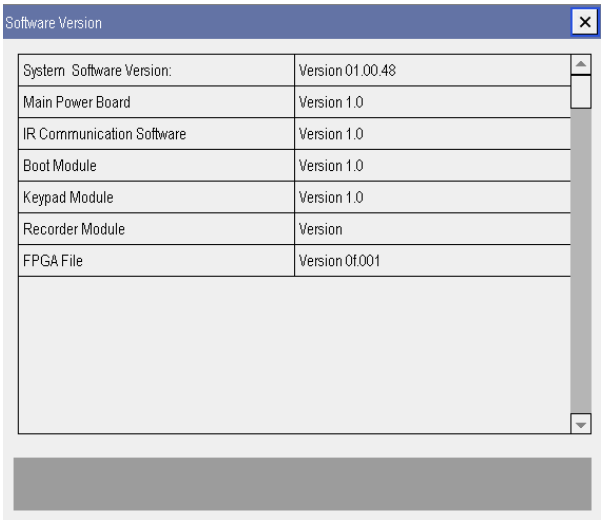
To enable/disable the recorder, select [**Recorder**] and toggle between [**On**] and [**Off**].

⚠CAUTION

- **The recorder is disabled if [Recorder] is switched off in the [Factory Maintenance] menu.**

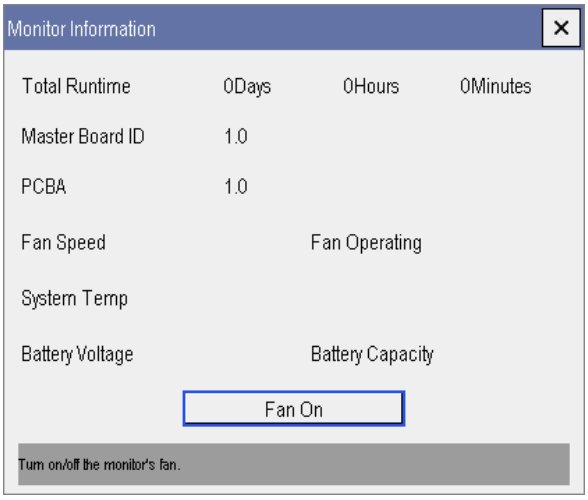
3.10.4 Software Version

Selecting [**Software Version**] will show software version information. The display of [**Software Version**] menu is as follows:



3.10.5 Monitor Information

Selecting [**Monitor Information**] will show the status of the patient monitor. Monitor information is displayed as follows:



3.10.6 Calibrate NIBP

For details, refer to section ***3.4.5 NIBP Tests*** .

3.11 Program Upgrade

You can upgrade the software of the patient monitor by downloading the upgrade software through network. At the same time, you can view the upgrade status log. The upgrade software can directly run on a portable PC or desktop PC. Through the network or by connecting the patient monitor to a PC via a crossover network cable, you can upgrade the following programs:

- Boot program
- System program
- Multilingual library
- BMP files (including screen icons, start-up screens, standby screens)
- General configurations (including passwords, company logo)
- System functional configuration
- FPGA program
- Integral module rack program
- Satellite module rack program
- Parameter module programs: MPM, IBP module, C.O. module, sidestream CO_2 module, RM module

For details, refer to help and instructions for program upgrade.

⚠CAUTION

- **Disconnect the patient monitor from the patient and make sure the important data are saved before upgrade.**
- **Do not shut down or power off the equipment when upgrading the boot program. Otherwise, it may cause the equipment to break down.**
- **Program upgrade should be performed by qualified service personnel only.**

NOTE

- **After upgrading the boot program, re-upgrade the system program and other programs to ensure compatibility.**
- **Make sure the version of the upgrade package is you desired one. If you want to obtain the latest upgrade package, contact our Customer Service Department.**

FOR YOUR NOTES

4 Troubleshooting

4.1 Introduction

In this chapter, patient monitor problems are listed along with possible causes and recommended corrective actions. Refer to the tables to check the patient monitor, identify and eliminate the troubles.

The troubles we list here are frequently arisen difficulties and the actions we recommend can correct most problems, but not all of them. For more information on troubleshooting, contact our Customer Service Department.

4.2 Part Replacement

Printed circuit boards (PCBs), major parts and components in the patient monitor are replaceable. Once you isolate a PCB you suspect defective, follow the instructions in ***Repair and Disassembly*** to replace the PCB with a known good one and check that the trouble disappears or the patient monitor passes all performance tests. If the trouble remains, exchange the replacement PCB with the original suspicious PCB and continue troubleshooting as directed in this chapter. Defective PCB can be sent to us for repair.

To obtain information on replacement parts or order them, refer to ***Parts.***

4.3 Patient Monitor Status Check

Some troubleshooting tasks may require you to identify the hardware version and status of your patient monitor.

1. To view the information on system start time, self check, etc., select [**Main Menu**]→[**Maintenance >>**]→[**Monitor Information >>**].
2. You can also view the information on the monitor's current status by selecting [**Main Menu**]→[**Maintenance>>**]→[**Factory Maintenance>>**]→enter the required password →[**Monitor Information >>**].

4.4 Software Version Check

Some troubleshooting tasks may require you to identify the configuration and software version of your patient monitor.

1. To view information on the system configuration and system software version, Select [**Main Menu**]→[**Maintenance>>**]→[**Software Version>>**].
2. You can also view the information on system software version and module software version by selecting [**Main Menu**]→[**Maintenance>>**]→[**Factory Maintenance>>**]→ enter the required password →[**Software Version>>**].

4.5 Technical Alarm Check

Before troubleshooting the patient monitor, check for technical alarm message. If an alarm message is presented, eliminate the technical alarm first. For detailed information on technical alarm message, possible cause and corrective action, refer to the patient monitor's Operation Manual.

4.6 Troubleshooting Guide

4.6.1 Power On/Off Failures

Symptoms	Possible Cause	Corrective Action
The patient monitor fails to start. AC LED or battery LED does not light	AC mains not connected or battery too low	Check that AC mains is properly connected or battery capacity is sufficient.
	Power supply protection	Refer to ***4.6.9 Power Supply Failures*** .
	Cables defective or poorly connected	1. Check that the cables from power switch & LED board to button board, button board to main board, and power module to main board are correctly connected. 2. Check that cables and connectors are not damaged.
	Power switch & LED board defective	Replace the power switch & LED board.
	Power module defective	Replace the power module.
	Mother board Defective	Replace the mother board.

4.6.2 Display Failures

Symptoms	Possible Cause	Corrective Action
Integrated display is blank but the patient monitor still works correctly.	Cables defective or poorly connected.	1. Check that the cable from the display to the mother board and the cables from the backlight board respectively to the button board and the display are correctly connected. 2. Check that the cables and connectors are not damaged.
	Backlight board defective	Replace the backlight board.
	Power module defective	Replace the power module.
	Display defective	Replace the display.
Secondary display does not function.	Cables defective or poorly connected.	1. Check that the cable between the display and the patient monitor is correctly connected. 2. Check that the cables and connectors are not damaged.
	DVI interface board defective	Replace the DVI interface board.
Secondary display displays snows or flashing specks	Cables defective or poorly connected.	1. Check that the cable between the display and the patient monitor is correctly connected. 2. Check that the cables and connectors are not damaged.
	DVI interface board defective	Replace the DVI interface board.
	The mother board is damaged.	Replace the mother board.
Images overlapped or distorted	FPGA error.	Update or upgrade FPGA.
	Cables defective or poorly connected.	1. Check that the cable between the display and mother board is correctly connected. 2. Check that the cables and connectors are not damaged.
Touchscreen does not response	Touchscreen disabled	Check if there is a symbol shown above the [**Measurements**] QuickKey. If yes, press the [**Measurements**] QuickKey for more than 3s to enable the touchscreen.

	Cables defective or poorly connected.	1. Check that the cables from the touchscreen to the touchscreen control board, the touchscreen control board to the button board, and the button board to the mother board are correctly connected. 2. Check that the cables and connectors are properly connected
	Touchscreen control board defective	Replace the touchscreen control board
	Button board defective.	Replace the button board.
	Touchscreen defective.	Replace the touchscreen
	Mother board defective	Replace the mother board
Touch position invalid	Touchscreen not calibrated	Calibrate the touchscreen

4.6.3 Module Rack Failures

Symptoms	Possible Cause	Corrective Action
SMR		
SMR cannot identify parameter modules	Extension Cable defective or poorly connected	1. Check that the cable between SMR and main unit is properly connected 2. Check that the connecting cables and connectors are not damaged. 3. Check that contact screws on SMR are tightly screwed and properly contact the SMR.
	Defective parameter module	Replace the suspicious parameter module with a known good module. Check if the patient monitor identifies the replacement module. If yes, it means that the original one is defective.
	Wrong communication board software revision	Upgrade the program of the module or SMR.
	Module (in some slots) not recognized	Replace the Nios II module. Replace the 8-slot module rack communication board.
	Power supply failure	1. Check if the voltage between two contact screws in any slot reaches 12V DC. If yes and the parameter module functions properly and the PCB assembly in SRM might fail. 2. If there is no 12 VDC power sent to the SMR, check whether the power voltage output to the USB_Hub board by the power module reaches 12V. If yes, the fuse of the USB interface board might blow. Replace the USB_Hub board.
	Cable defective or poorly connected	1. Check that the cable between SMR interface board and communication board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Nios II module loose or failure	1. Check that Nios II module is correctly plug ed 2. If the symptom persists, replace the Nios II module.
	SMR interface board failure	Replace the SMR interface board.

	SMR communication board failure	Replace the SMR communication board.
	USB_Hub board failure	Replace the USB_Hub board.
	Mother board failure	Replace the mother board.
Integral module rack		
Integral module rack cannot identify parameter modules	Module failure	Replace parameter module. If a new module is identified, the original one is defective.
	Cable defective or poorly connected	1. Check that the cables from 3-slot module rack communication board to MPM module rack communication board, module rack to mother board are properly connected. 2. Check that connecting cables and connectors are not damaged.
	Wrong communication board software revision	Upgrade the program of the module or Integral module rack.
	Module (in some slots) unrecognized	Replace the Nios II module. Replace the corresponding module rack communication board.
	Power supply to integral module rack abnormal	1. Check if voltage between two contact screws in any slot reaches 12VDC. If yes and the parameter module functions, PCB assembly in the SMR might fail. 2. If there is no 12V sent to the integrated module rack, check that power module output voltage to mother board reaches 12V DC. If yes, mother board might fail.
	3-slot or MPM module rack communication board failure	Replace the 3-slot or MPM module rack communication board.
	Nios II module failure	Replace the Nios II module.
	Mother board failure	Replace the mother board.

4.6.4 Alarm Problems

Symptoms	Possible Cause	Corrective Action
The alarm lamp is not light or extinguished but alarm sound is issued	Cable defective or poorly connected	1. Check that cables from alarm LED board to button board and button board to mother board are properly connected. 2. Check that connecting cables and connectors are not damaged.
	Alarm LED board failure	Replace the alarm LED board.
	Button board failure	Replace the button board.
	Mother board failure	Replace the mother board.
No alarm sound is issued but alarm lamp is light	Audio alarm disabled	Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Alarm Setup >>**], and then in the popup menu, set [**Alm Sound**] to [**On**].
	Cable defective or poorly connected	1. Check that cable between speaker and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	FPGA audio logic error	Upgrade the audio logic part of the FPGA program.
	Speaker failure	Replace the speaker.
	Mother board failure	Replace the mother board.

4.6.5 Button and Knob Failures

Symptoms	Possible Cause	Corrective Action
Buttons do not work	Cable defective or poorly connected	1. Check that cable between button board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Button board failure	Replace button board.
Knob does not work	Cable defective or poorly connected	1. Check that cables from knob to button board, and button board to mother board are properly connected 2. Check that connecting cables and connectors are undamaged.
	Knob failure	Replace the knob encoder.
	Button board failure	Replace the button board

4.6.6 Recorder Failures

Symptoms	Possible Cause	Corrective Action
No printout	Recorder module disabled	1. Check if the recorder status LED lights 2. If yes, enable the module in [**Factory Maintenance**] menu. Otherwise, check for other possible causes.
	Paper reversed	Re-install the paper roll.
	Cable defective or poorly connected	1. Check that cable between recorder and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	Recorder power supply failure	Check if the power module outputs 5 V DC and 12V DC correctly.
	Recorder failure	Replace the recorder.
Poor print quality or paper not feeding properly	Paper roll not properly installed	Stop the recorder and re-install the paper roll.
	Print head dirty	1. Check the thermal print head and the paper roller for foreign matter. 2. Clean the thermal print head with an appropriate clean solution.
	Recorder failure	Replace recorder.

4.6.7 Output Interface Failures

Symptoms	Possible Cause	Corrective Action
No analog signals or nurse call signals are issued	Respective output disabled	1. Select [**Main Menu**]→[**Analog Output Setup**]→set [**Analog Output**] to [**On**]. 2. Select [**Main Menu**]→[**Maintenance**>>]→[**User Maintenance** >>]→enter the required password→[**Others** >>]→[**Auxiliary Output**]→select desired output.
	USB_Hub board cable loose	1. Check that cable between USB_Hub board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	USB_Hub board failure	Replace the USB_Hub board.
	Mother board failure	Replace the mother board.
Device with USB port does not function (Assume that the peripheral devices are good)	Cable defective or poorly connected	1. Check that cable between USB_Hub board and mother board is properly connected. 2. Check that connecting cables and connectors are not damaged.
	USB_Hub board failure	Replace the USB_Hub board.
	Mother board failure	Replace the mother board.

4.6.8 CF Card Problems

Symptoms	Possible Cause	Corrective Action
CF card malfunctions	Wrong CF card or small memory space	Use only SanDisk-manufactured CF storage cards. Those with 1GB memory space are recommended.
	Cable defective or poorly connected	1. Check that the cable between CF card board and mother board is correctly connected. 2. Check that connecting cables and connectors not damaged.
	CF card board failure	Replace the CF card board.
	Mother board failure	Replace the mother board.

4.6.9 Power Supply Failures

Symptoms	Possible Cause	Corrective Action
Different battery voltages	Battery failure	Replace battery.
	Cable defective or poorly connected	1. Check that the cable between battery interface board and power module is correctly connected. 2. Check that cables and connectors are not damaged.
	Power board failure	Replace the power board.
Battery capacity is too low	Battery failure	Replace battery.
	Cable defective or poorly connected	1. Check that the cable is correctly connected. 2. Check that connecting cables and connectors are not damaged.
	Power board failure	Replace the power board.
Battery cannot be recharged	Battery failure	Replace battery and recharge the replacement battery. If the replacement battery can be recharged, the original one fails.

	Cable defective or poorly connected	1. Check that cable between battery interface board and power module is correctly connected. 2. Check that cables and connectors are not damaged.
	Power board failure	Replace power board
No +3.3 V output	1. Power supply protected 2. Power board failure	1. Turn off the patient monitor then restart it. 2. If the problem remains, disconnect the AC mains for 5 s and reconnect it, then restart the patient monitor. 3. If the problem still remains, replace the power board.
No +5.0 V output		
No +12 V output		

NOTE

- **When the power module has a failure, it may cause problems to other components, e.g. the monitor suddenly breaks down during start-up, as the power module may have a power supply protection. In this case, troubleshoot the power module per the procedure described in the table above.**
- **Components of the main unit, SMR and parameter modules are powered by the power module. In the event that a component malfunctions, check if the operating voltage is correct. Refer to *2 Theory of Operation* for the operating voltage and measurement points of each component.**

4.6.10 Network Related Problems

Symptoms	Possible Cause	Corrective Action
The patient monitor cannot be connected to a CIS.	No connection to LAN	1. Check that network cables and connectors are in good condition and that the network is correctly connected. 2. Check that the connectors of the junction box used to connect the CIS and the patient monitor are in good condition.
	CIS failure	Change the CIS.
	DVI interface board failure	Replace DVI interface board.
Frequent dropouts and network disconnects	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50 m.
	Incorrect IP address configuration	Check for IP address conflict. Reconfigure IP address.
The patient monitor is connected to a LAN but cannot view other patients in the View Others mode	Incorrect LAN cable connection	Check LAN cable connection. LAN cable shall not be longer than 50m.
	Excessive requests for viewing the patient monitor at the same time	A patient monitor can only be viewed by 4 other patient monitors at the same time under the View Others mode. The excessive view requests system will be ignored.
	Incorrect IP configuration	Check for IP address conflict. Reconfigure IP address.
	USB_Hub board failure	Replace the USB_Hub board.

4.6.11 Software Upgrade Problems

Symptoms	Possible Cause	Corrective Action
Bootstrap upgrade fails	Power failure or unintended power off during bootstrap upgrade	Return the CPU board to factory for repair.
Program upgrade fails	Incorrect network connection	1. Check that network connector, not CIS connector, on the patient monitor is used. 2. Make sure that the hub or switch run normally. Check that net twines are of the right type and have been connected correctly.
	Wrong upgrade package has been downloaded	Upgrade package shall be .pkg files. Select package according to system requirement.
	Incorrect IP address configuration	Configure a fixed IP address in range C as specified for the patient monitor. We recommend not to upgrade a program when the patient monitor is connected to a network with multiple PCs.

FOR YOUR NOTES

5 Repair and Disassembly

5.1 Tools

During disassembly and replacing, the following tools may be required:

- Phillips screwdrivers
- Small flat-bladed screwdrivers
- Contact spanner
- Tweezers
- Sharp nose pliers
- Sleeve

5.2 Preparations for Disassembly

Before disassembling the monitor, finish the following preparations:

- Stop monitoring the patient, turn off the monitor and disconnect all the accessories and peripheral devices.
- Disconnect the AC power source and take out both of the batteries.
- Pull off all the modules in the integral module rack. If the SMR is connected, disconnect the SMR from the monitor and then remove all the modules in it.

⚠WARNING

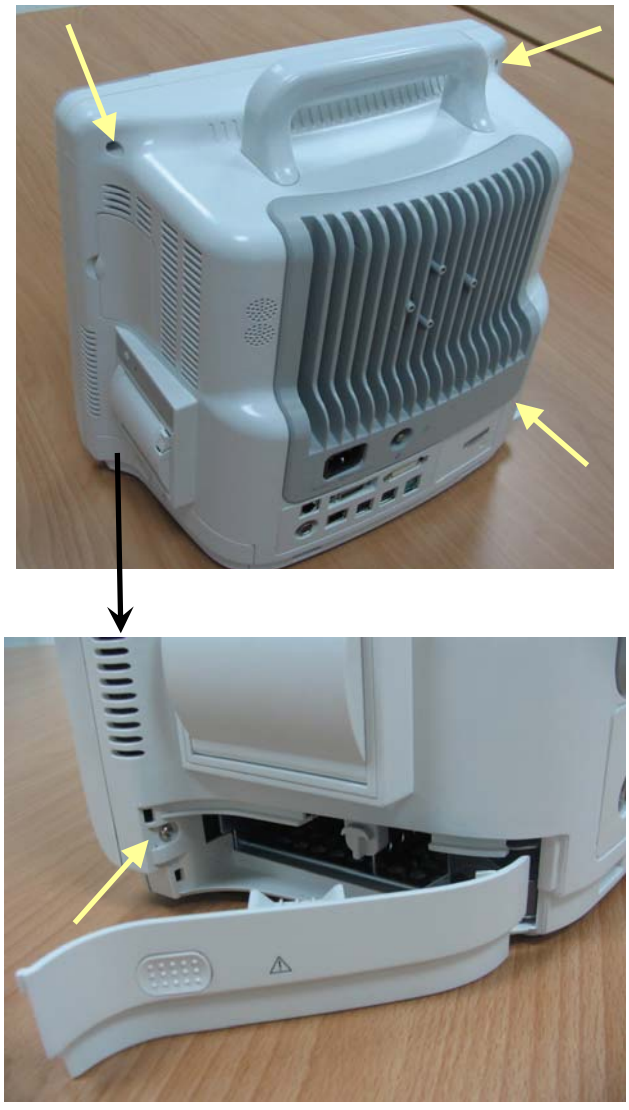
- **Before disassembling the monitor, be sure to eliminate the static charges first. When disassembling the parts labeled with static-sensitive symbols, make sure you are wearing electrostatic discharge protection such as antistatic wristband or gloves to avoid damaging the equipment.**
- **Put the cables or wires in place when reassemble the monitor to avoid short circuit.**
- **When assembling the monitor, be sure to select proper screws. If an unfit screw is tightened by force, the monitor may be damaged and the screw or the part may fall off during use to cause unpredictable damage or human injury.**

- **Be sure to follow the correct sequence to disassembly the monitor. Otherwise, the monitor may be damaged permanently.**
- **Be sure to disconnect all the cables before disassembling any parts. Be sure not to damage any cables or connectors.**
- **Be sure to place the monitor face up when disassembling it. Otherwise, the screen or the knob may be scratched or damaged.**

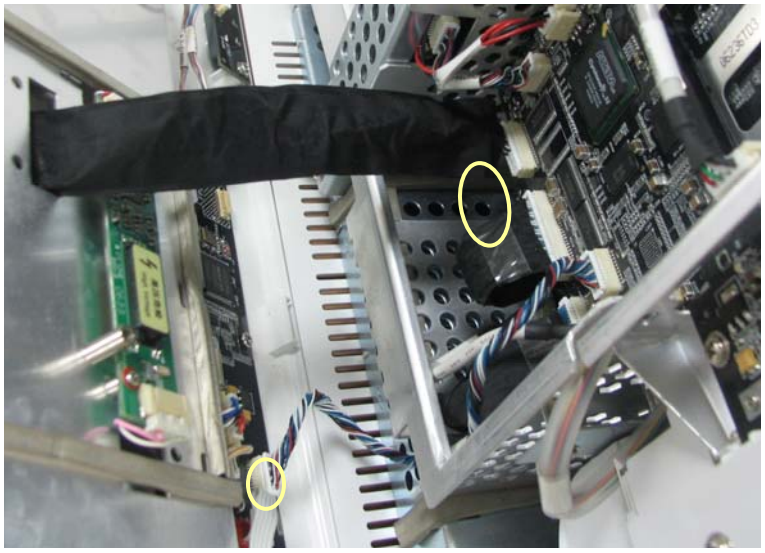
5.3 Disassembling Procedure

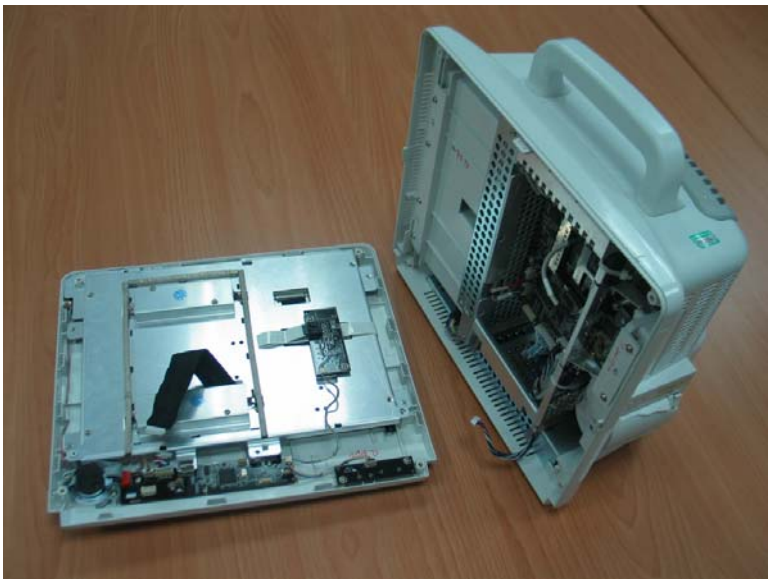
5.3.1 Separating the Front and Rear Housing

1. Unscrew the four M3×12 screws, one of which can be seen only when the battery door is openned.



2. Separate the front and rear housing and unplug the connecting cable between button board and main board as well as the cable between the LCD and the main board.



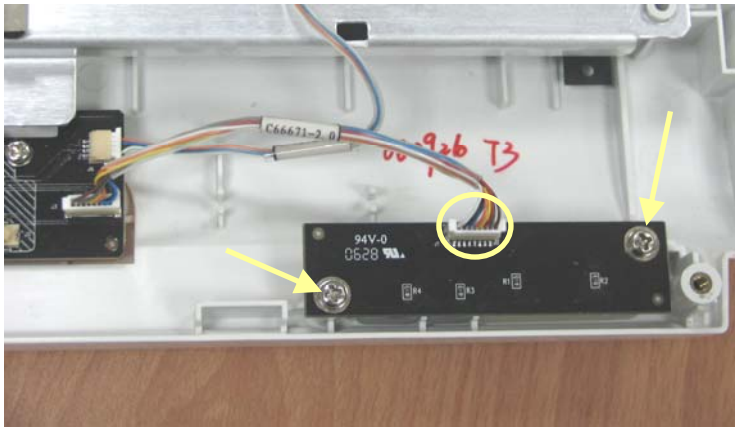


NOTE

- **Separate the front and rear housings with care. Make sure not to damage the cables and the connectors.**

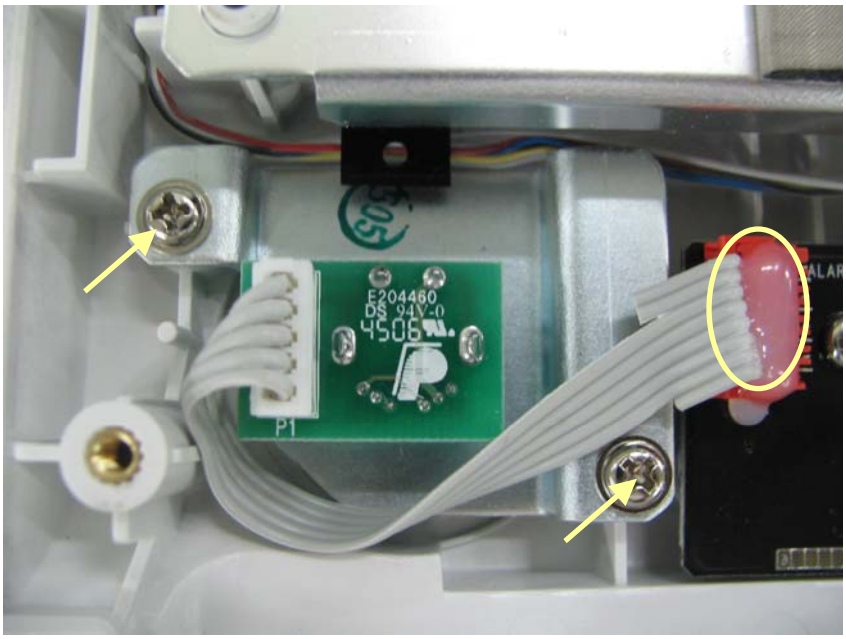
5.3.2 Removing the Power Switch & LED Board

1. Unplug the connecting cable between power switch & LED board and the button board. Unscrew the two M3×6 screws and remove the power switch & LED board.



5.3.3 Removing the Knob Encoder

1. Disconnect the cable that connects the knob encoder and the button board. Then unscrew the two M3×6 screws and take out the knob encoder.



5.3.4 Removing the Button Board

1. Disconnect the cables from the button board to the power switch & LED board, knob encoder, alarm LED board, backlight board, touchscreen control board and the mother board.

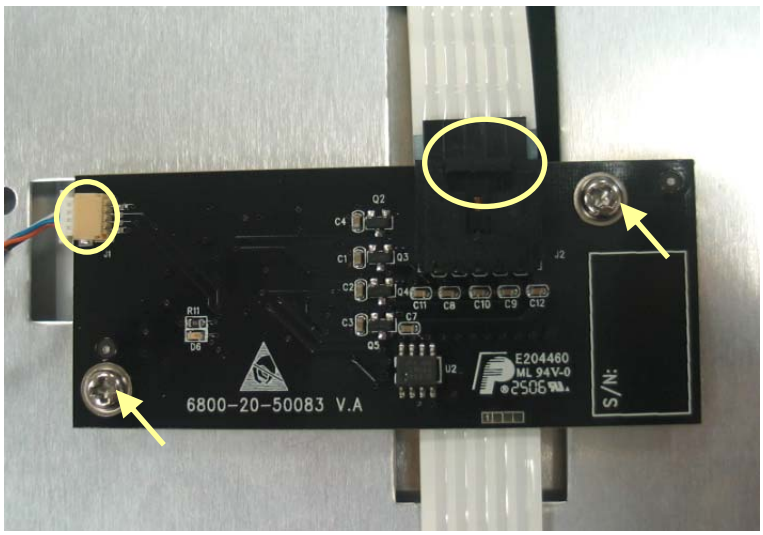
2. Unscrew the three PT3×8 screws and take out the button board.

5.3.5 Removing the LCD Assembly

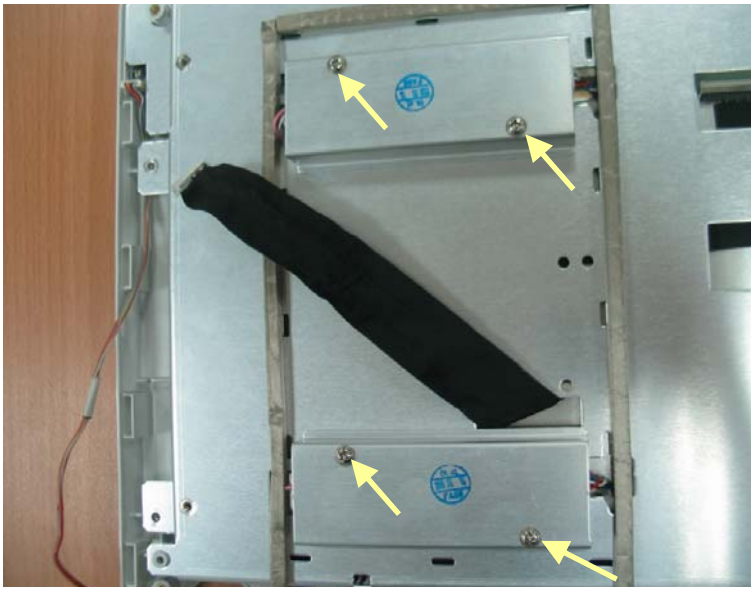
⚠CAUTION

- **Do not touch the LCD.**
- **Disassemble the LCD in an environment as dust-free as possible.**

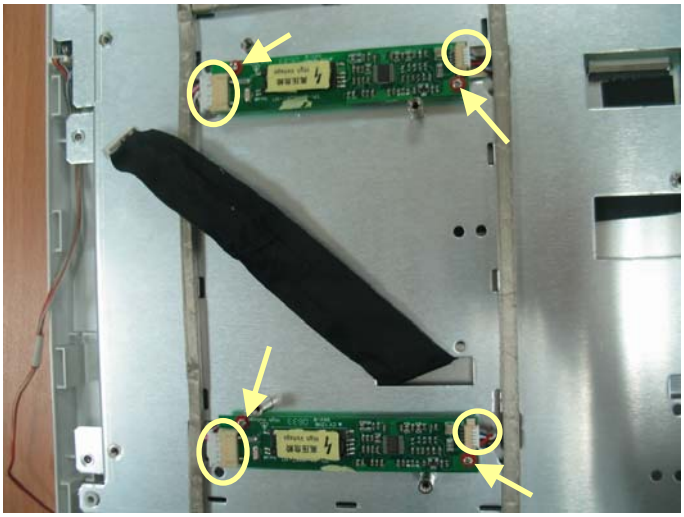
1. Unplug the cables respectively from the touchscreen and button board to the touchscreen control board. Then, unscrew the two M3×6 screws and remove the touchscreen control board.



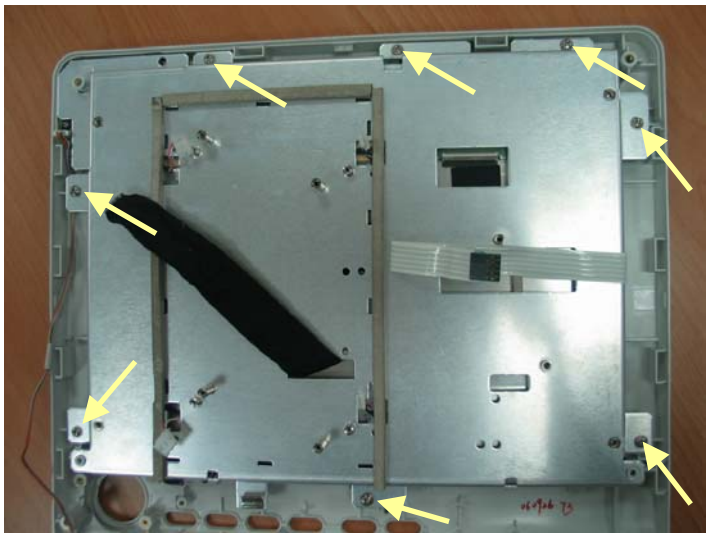
2. Unscrew the four M3×6 screws and remove the two backlight board shields.



3. Unplug the cables respectively from the button board and the LCD to the backlight board. Then, unscrew the M2×6 screws to remove the two backlight boards.

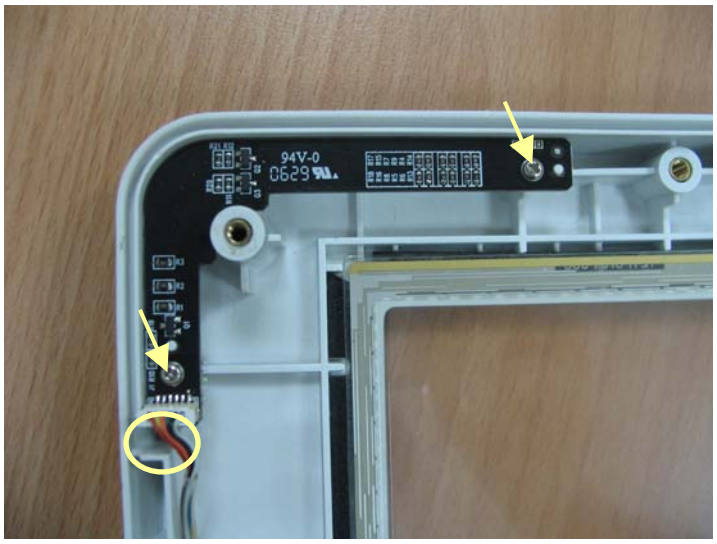


4. Unscrew the eight M3×6 screws and remove the LCD with care. Do not touch the LCD surface and prevent it from being contaminated by dust.



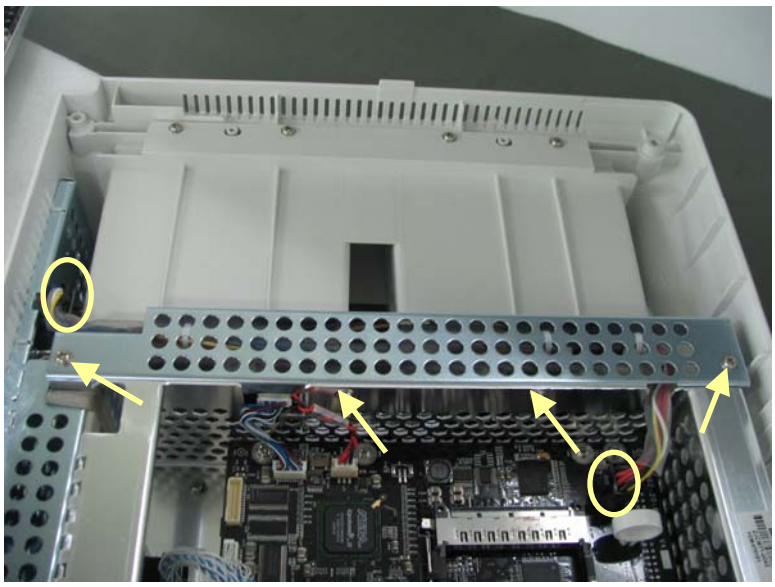
5.3.6 Removing the Alarm LED Board

1. After removing the LCD assembly, disconnect the cable that connects the alarm LED board and the button board, and then, unscrew the two PT2×6 screws to remove the alarm LED board.



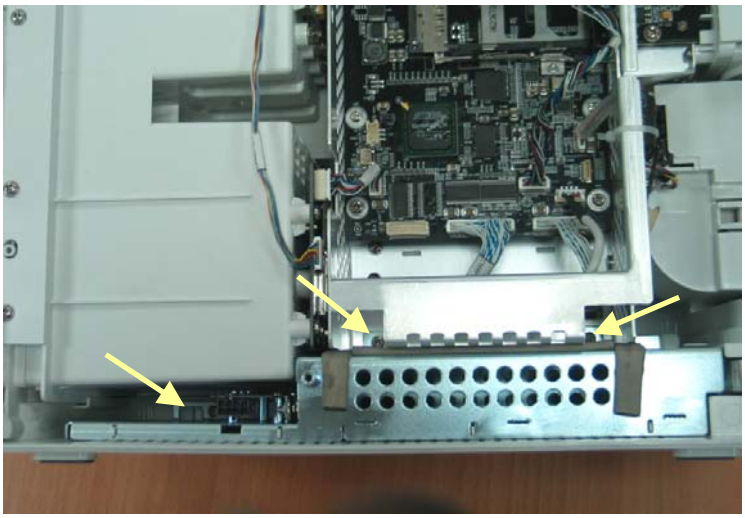
5.3.7 Removing the Fan Assembly

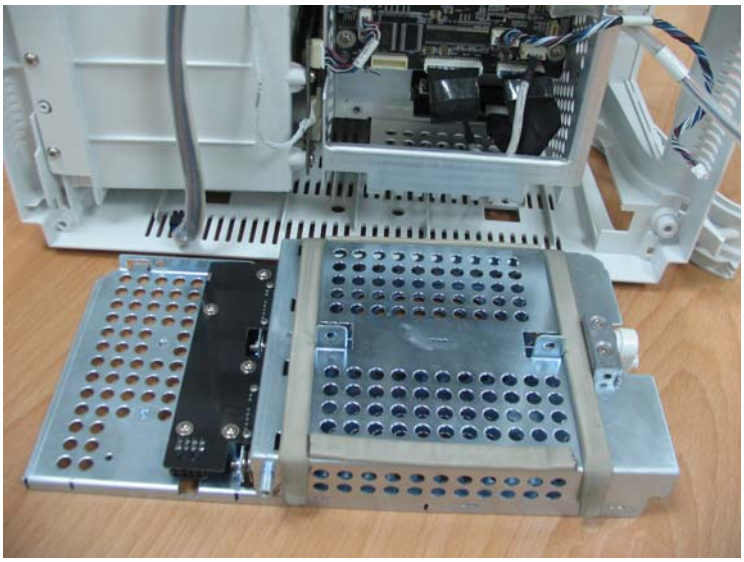
1. Unplug the cable that connects the fan assembly and the mother board. Then, unscrew the four M3×6 screws and remove the fan assembly.



5.3.8 Removing Battery Compartment Assembly

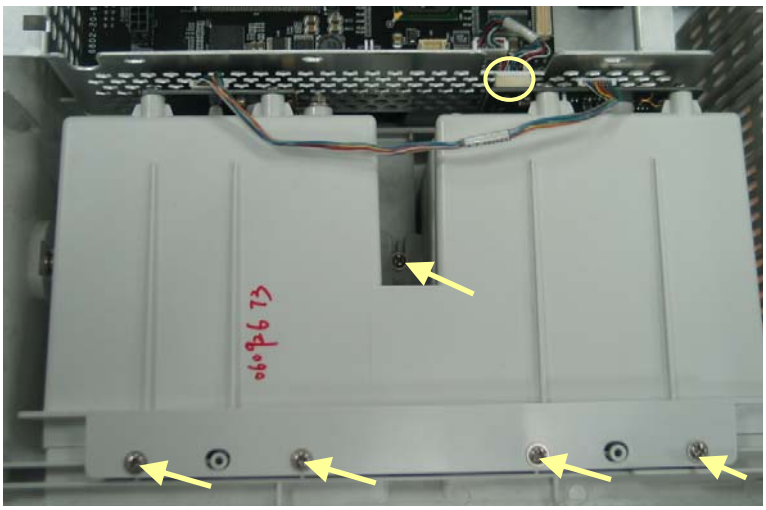
1. Unplug the cable that connects the battery compartment assembly and the mother board. Then, unscrew the three M3×6 screws and take out the battery compartment assembly.



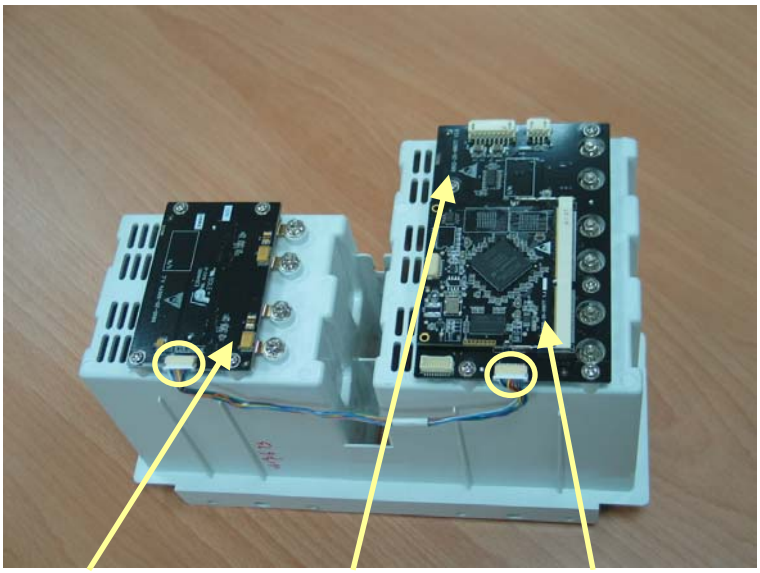


5.3.9 Removing the Integral Module Rack

1. Disconnect the cable that connects the integral module rack and the mother board. Unscrew the five M3×8 screws and remove the integral module rack.



2. Disconnect the cable that connects the MPM module rack communication board and the 3-slot module rack communication board. Release the two snaps and unplug the NiosII module on the 3-slot module rack.



MPM module rack communication board

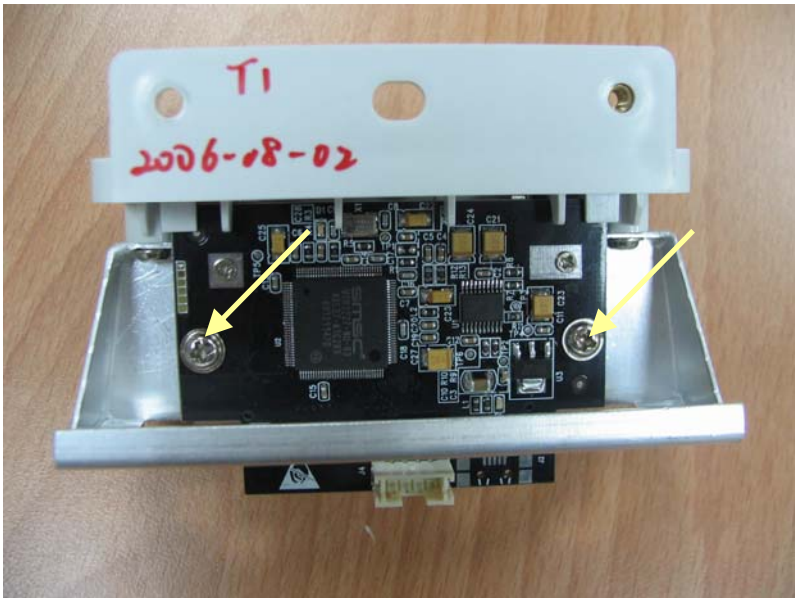
3-slot module rack communication board

NiosII module

5.3.10 Removing the CF Card Assembly

1. Unplug the cable that connects the CF card assembly and the mother board. Then, unscrew the two M3×6 screws and remove the CF card assembly.

2. Unscrew the two M3×6 screws and remove the CF card communication board.



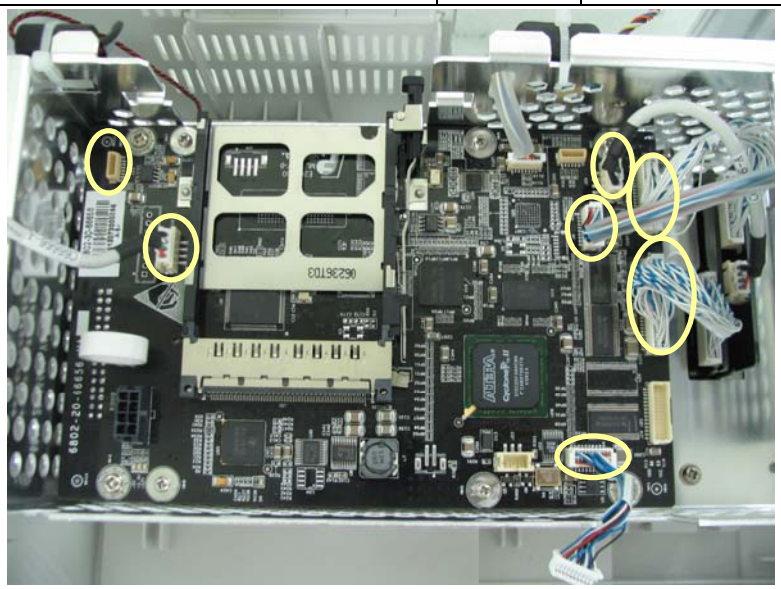
NOTE

- **When reassemble the CF card assembly, be sure to install the CF card door first.**

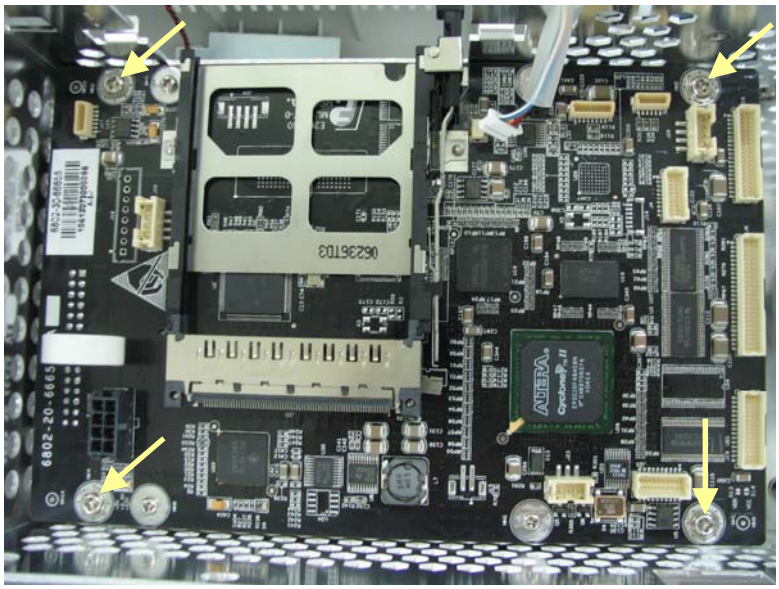
5.3.11 Removing the Main Board

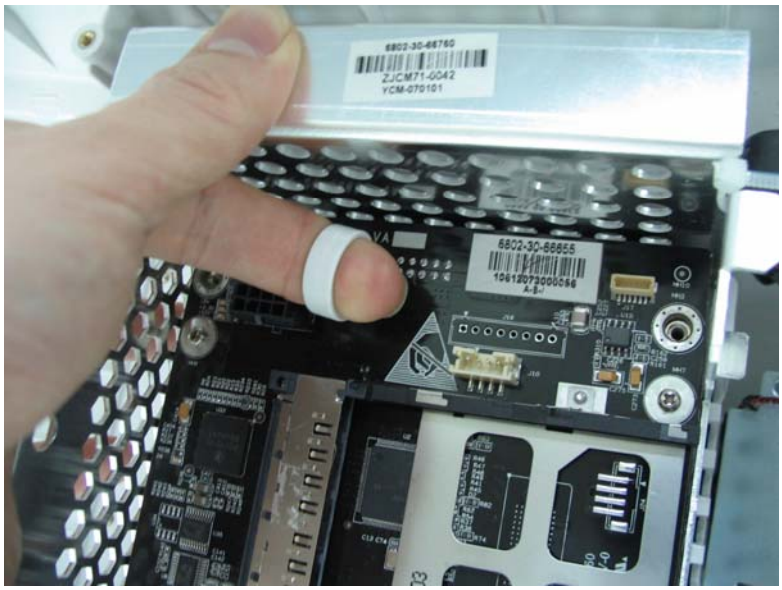
1. Unplug all the cables on the mother board. The numbers beside the connectors indicates what device is connected with the connector.

J4	Button board	J17	speaker
J5	Recorder	J19	LCD
J6	DVI interface board	J20	WLAN card
J7	Battery interface board	J23	Fan
J10	CF card board	J25	3-slot module rack communication board
J12	power board	J18、J26	USB_Hub board



2. Unscrew the 4 M3×6 screws and take out the main board assembly.

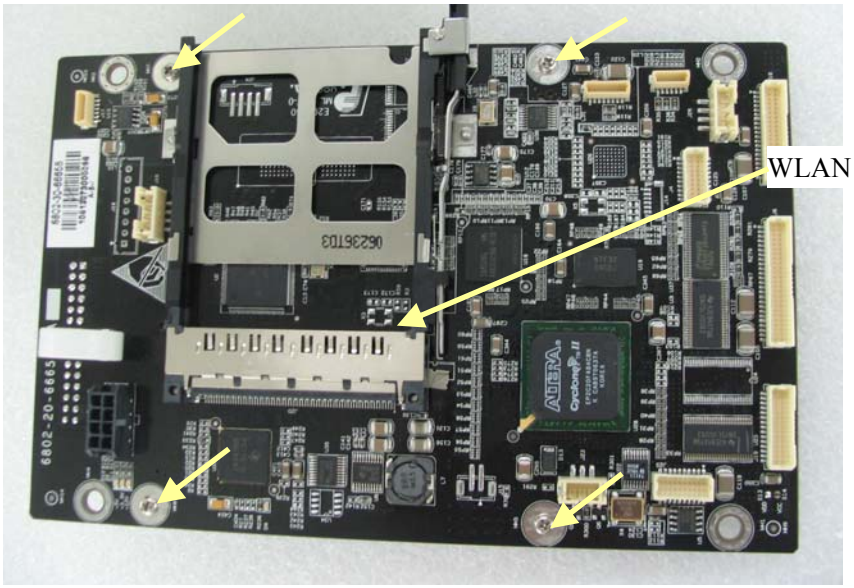


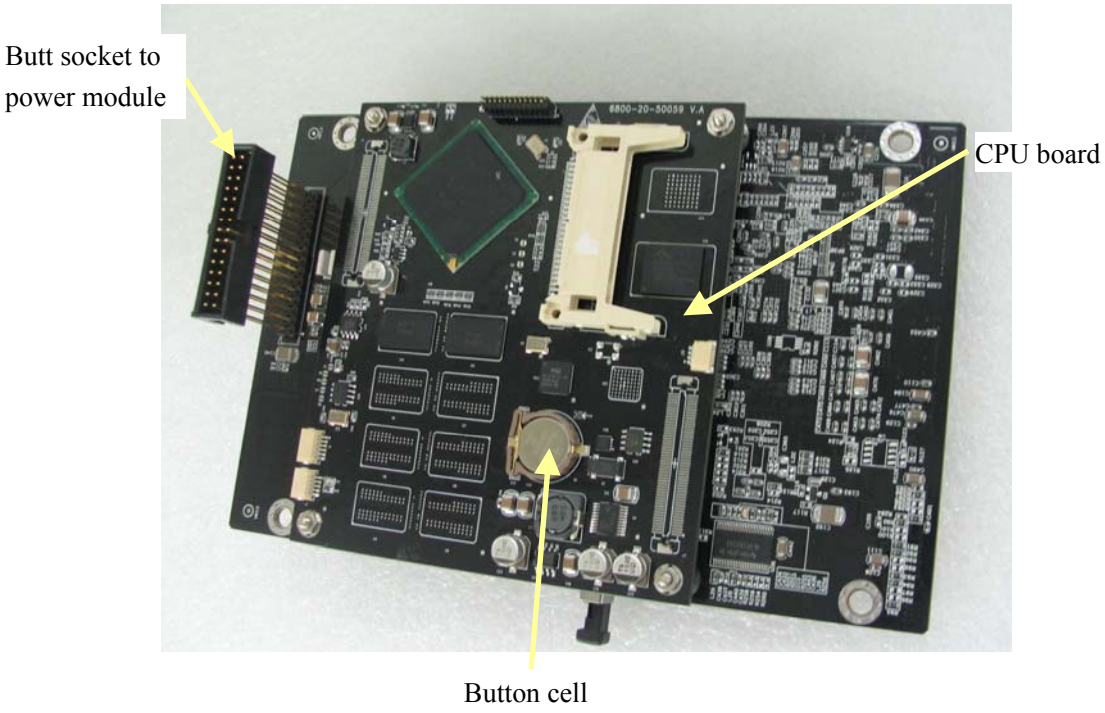


NOTE

- **Since the main board assembly is connected with the power module via a butt socket and the CPU radiator may be adhered to it, the main board assembly should be removed with force. Take care not to damage the butt socket.**

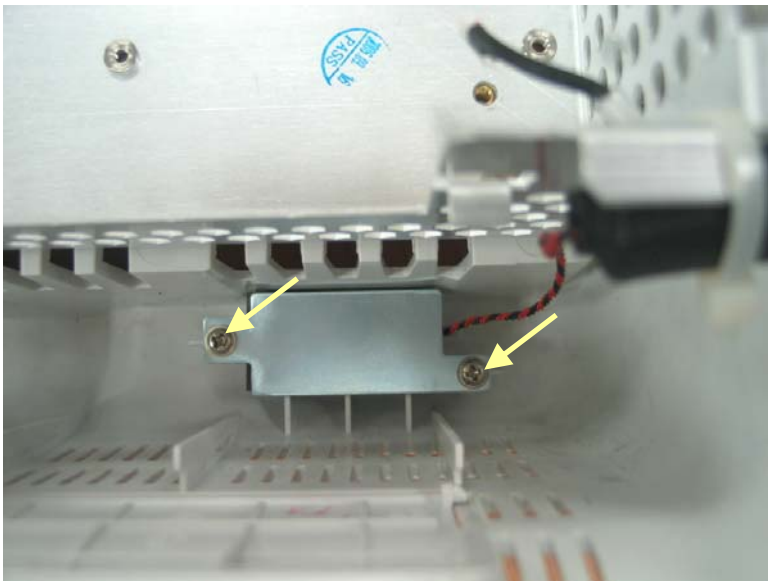
3. Unscrew the 4 M2.5×6 screws on the CPU board and vertically separate the CPU board and the mother board. Take care not to damage the butt socket.





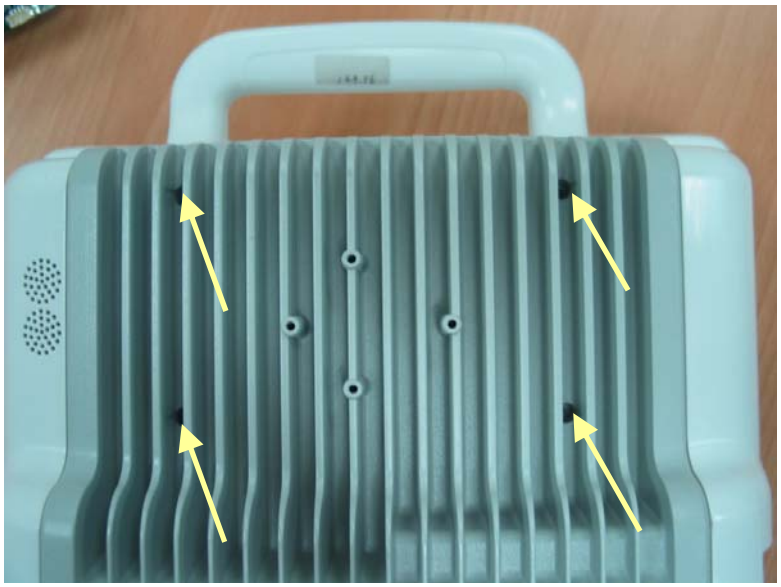
5.3.12 Removing the Speaker

1. Unscrew the two M3×6 screws and remove the speaker.



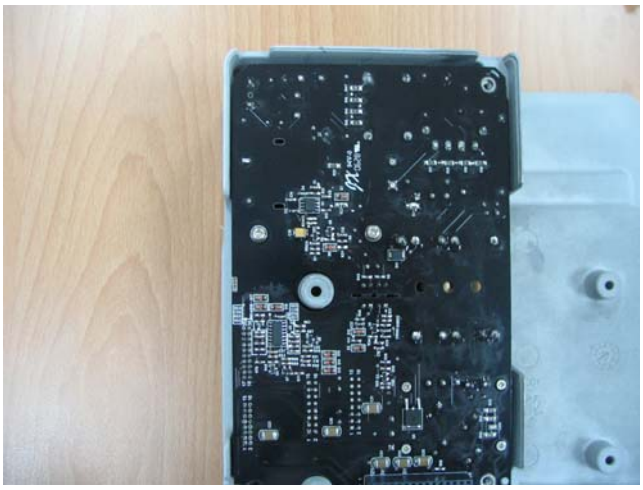
5.3.13 Removing the Power Module Assembly

1. Unscrew the 4 M3×12 screws and remove the power module assembly.

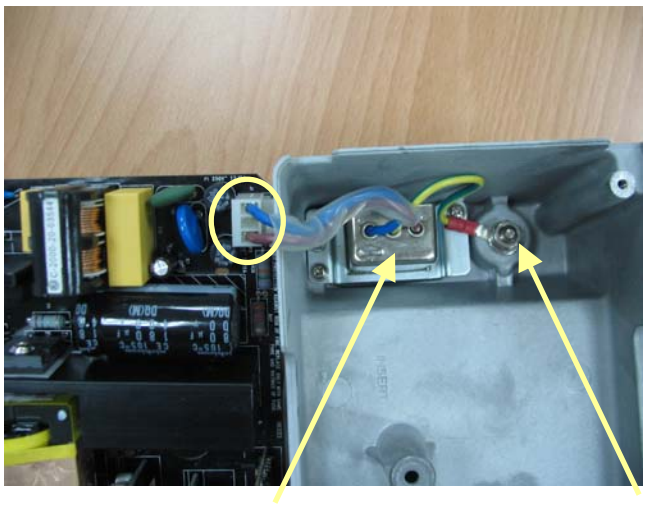


2. Unscrew the 3 M3×12 screws and remove the power supply cover.

3. Lift the power board with a small flat screwdriver. Then, turn it over.



4. Unplug the cable between the AC input filter and the power board, then remove the power board.



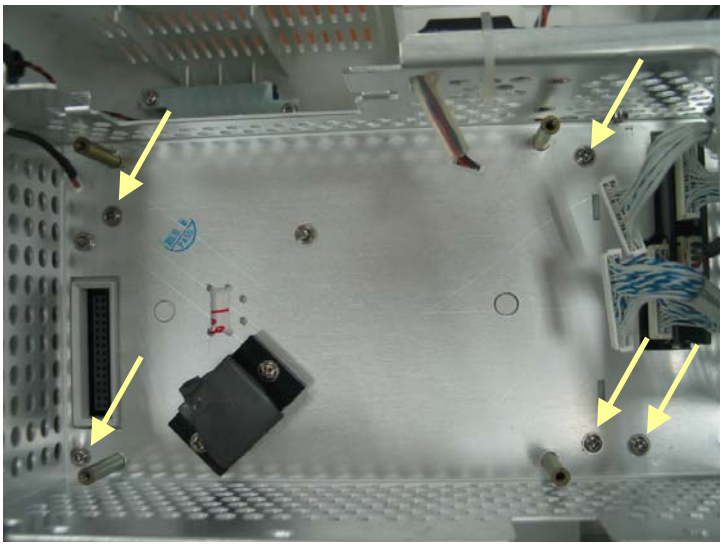
AC input filter Equipotential Pillar

NOTE

- **Since the power board may be adhered to the insulator, be careful not to damage the parts, connectors and cables on the power board when prizing it.**

5.3.14 Removing the Main Support

1. Unscrew the five M3×6 screws and disassemble the main support.



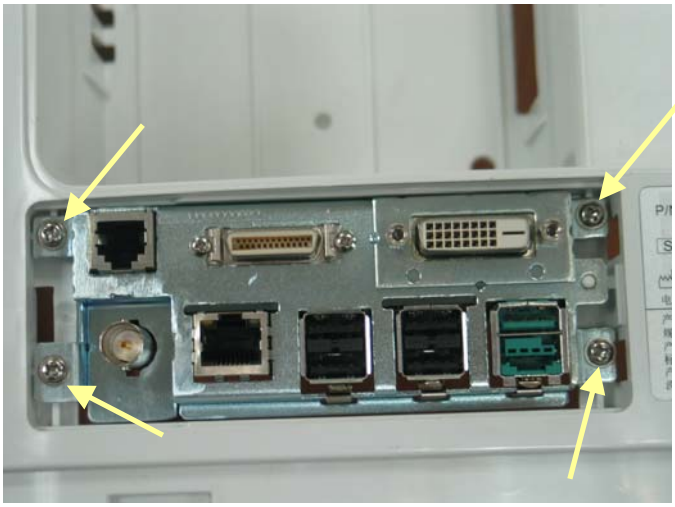
Note

- **Be sure to remove the power module first before removing the main support.**

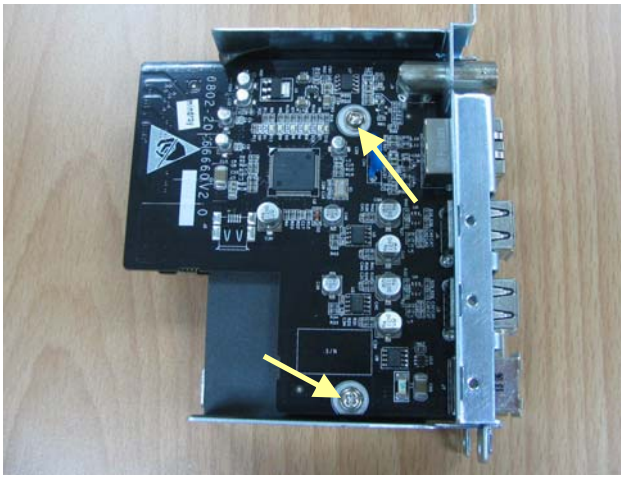
5.3.15 Removing the Interface Board Assembly

1. Release the clip that locks the interface board and push it outwards.

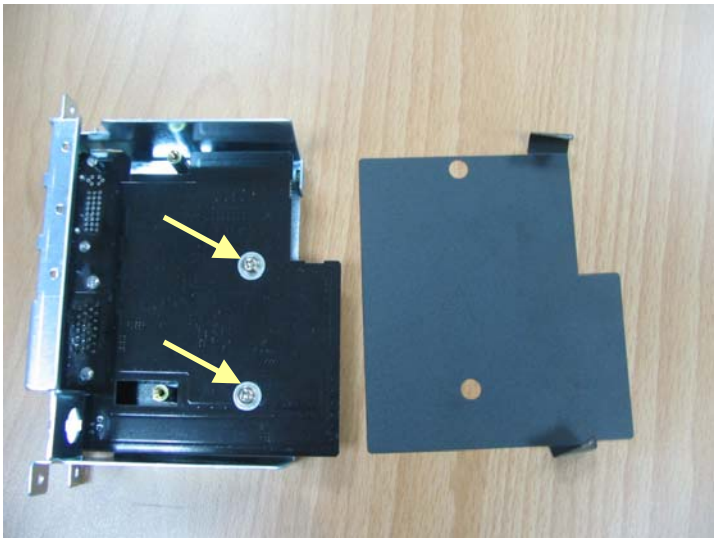
2. Open the interface board cover and unscrew the four M3×6 screws, then, unplug the interface board assembly.

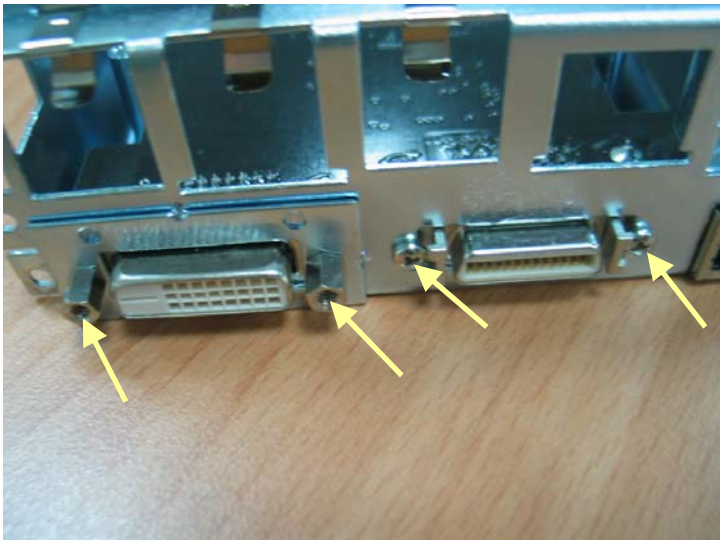


3. Unplug the cables on the interface board. Then unscrew the two M3×6 screws and remove the USB_Hub board.



4. Tear the insulating pad off the interface board. Then unscrew the two M3×6 screws, the two screws on the DVI interface board and the two M2.5×6 screws.



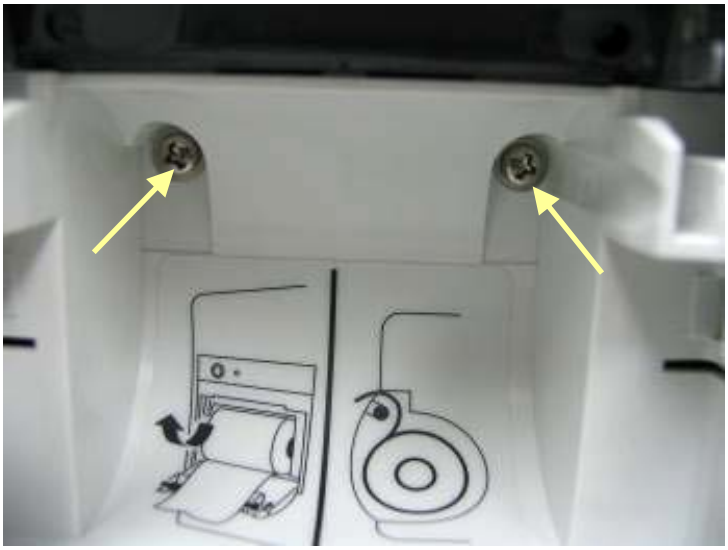


NOTE

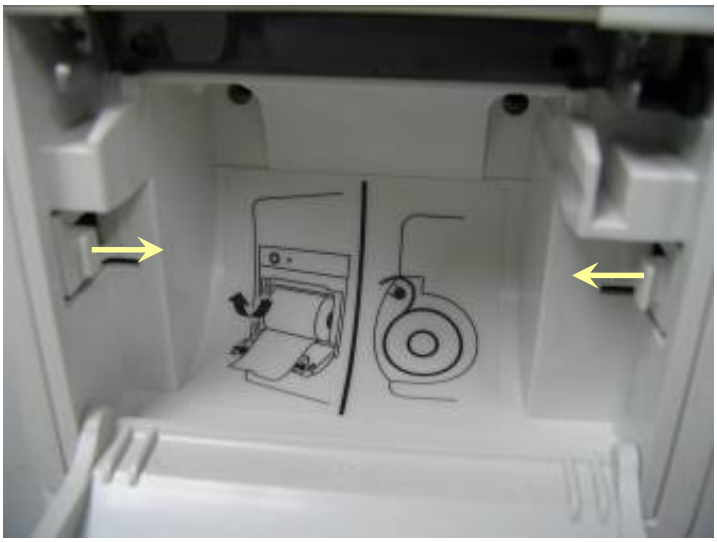
- **Before removing the USB interface board, the DVI interface board must be removed first.**
- **Be careful not to damage the insulation between the DVI interface board and the USB_Hub board. If it is damaged, stick a new one.**

5.3.16 Removing the Recorder

1. Open the recorder door and unscrew the two M3×6 screws.



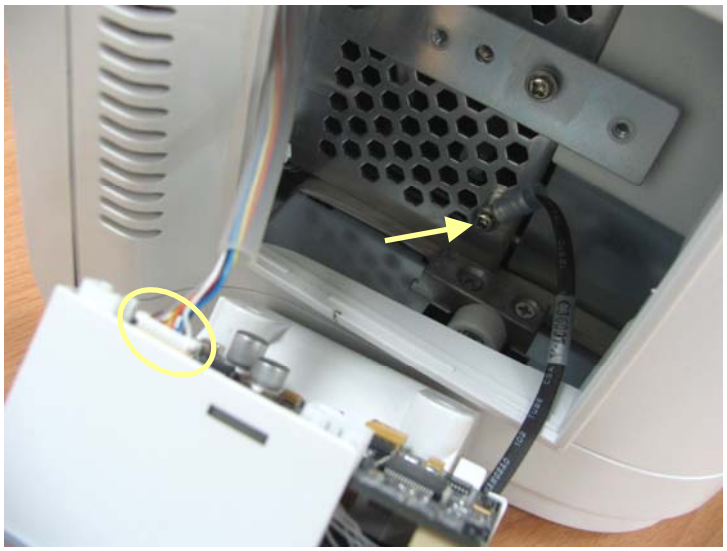
2. Pull the two clips in the directions as indicated and meanwhile pull out the recorder.



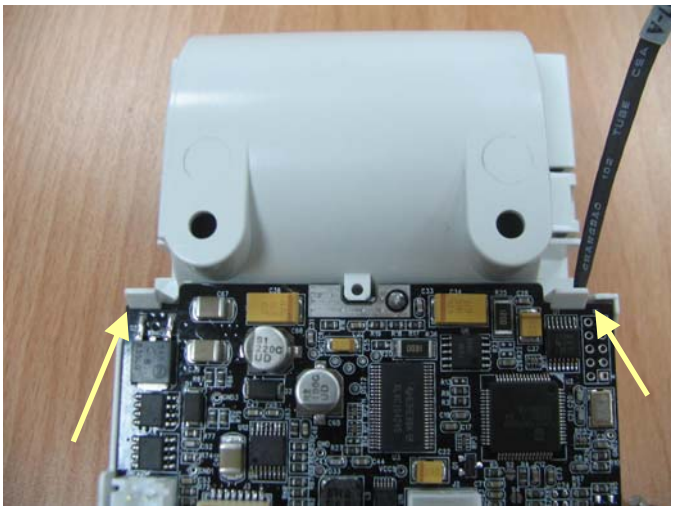
NOTE

- **Be sure not to damage the connecting cables or connectors when pulling out the recorder.**

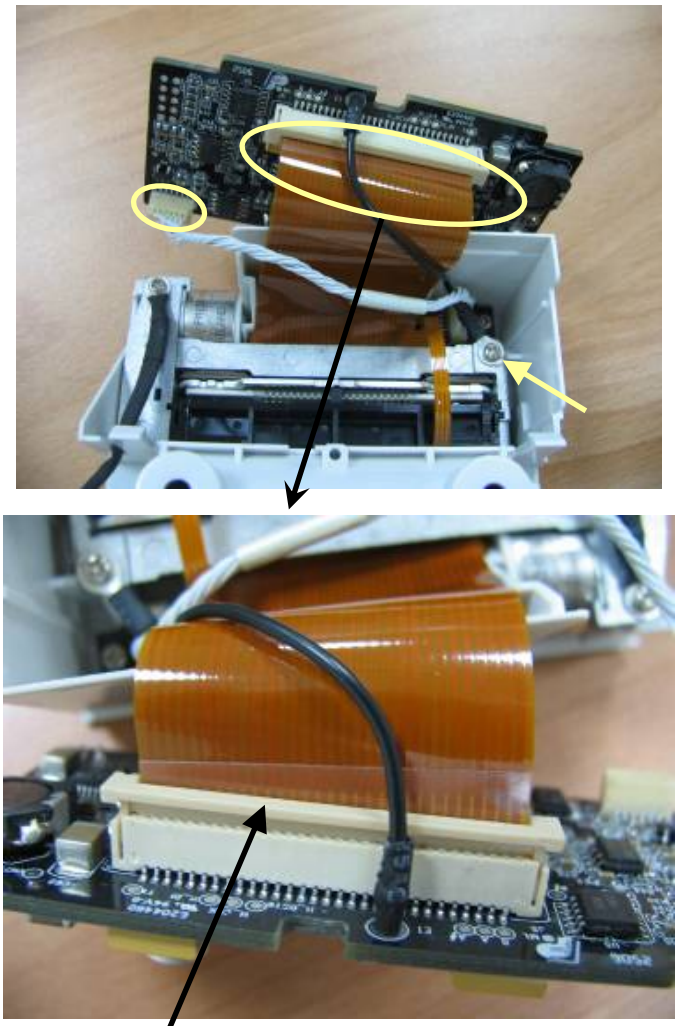
3. Unscrew the M3×6 screw and unplug the recorder grounding cable and the cable between the recorder and the mother board.



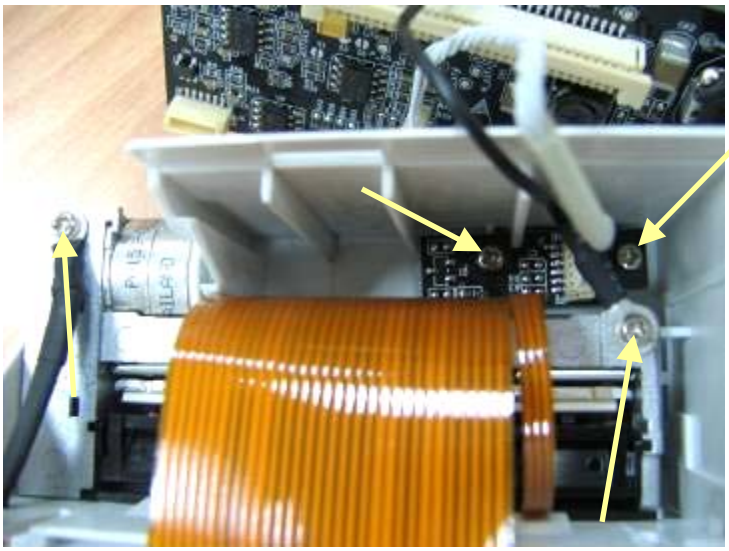
4. Pull the two clips backwards and remove the recorder driving board.

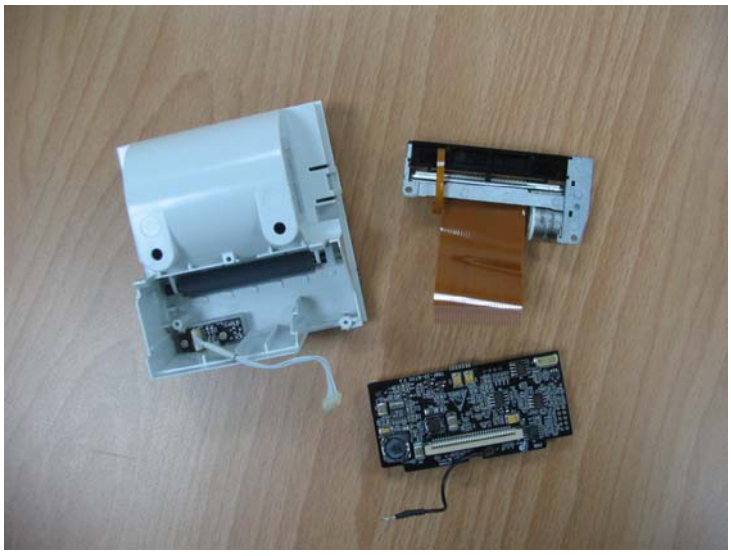


5. Pull the press bar upwards about 1 mm and then unplug the flexible cable. Remove the cable that connects the driving board and the button board. Unscrew the PT2×6 screw and remove the drive board's grounding cable. Then take out the recorder driving board.



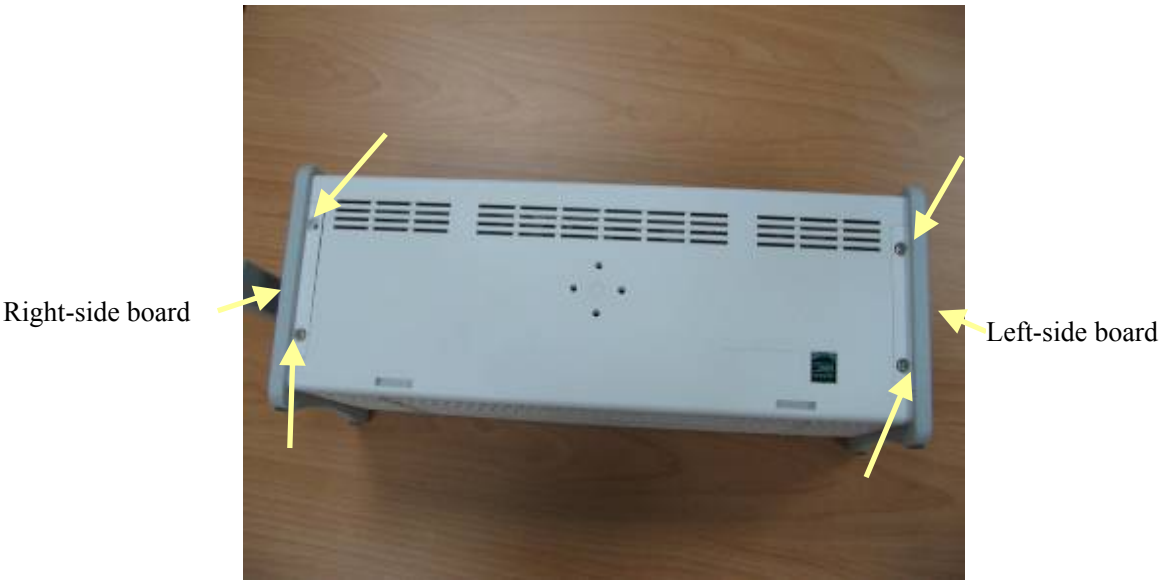
6. Unscrew the two PT2×6 screws and take out the thermal printhead. Then unscrew another two PT2×6 screws and remove the recorder's button board.





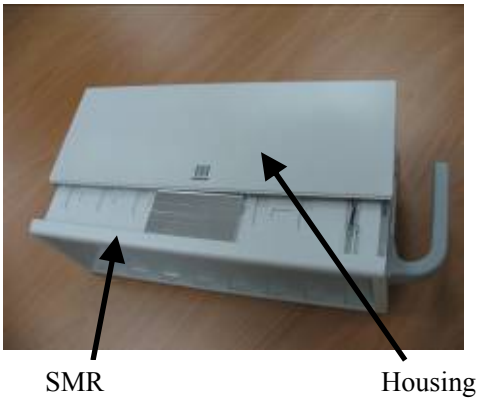
5.4 Removing the SMR Assembly

1. First remove the 4 screw covers and then unscrew the 4 M3×8 screws.

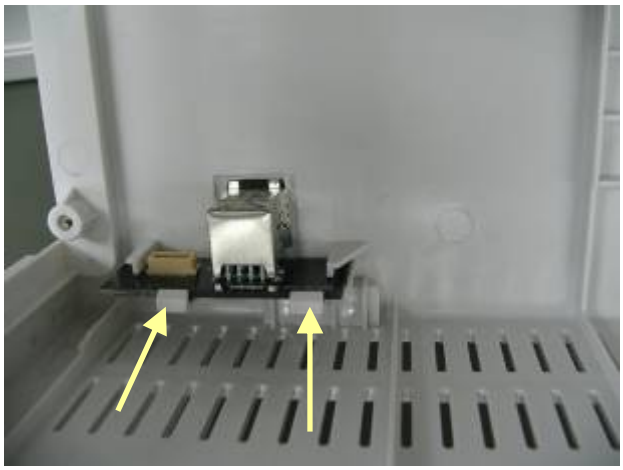


2. Pull the left- and right-side boards outwards. Be sure to place the rubber ring in position when reassembling the right-side board.

3. From the left side, remove the cable that connects the SMR interface board and the SMR communication board. Then take out the SMR from its housing.

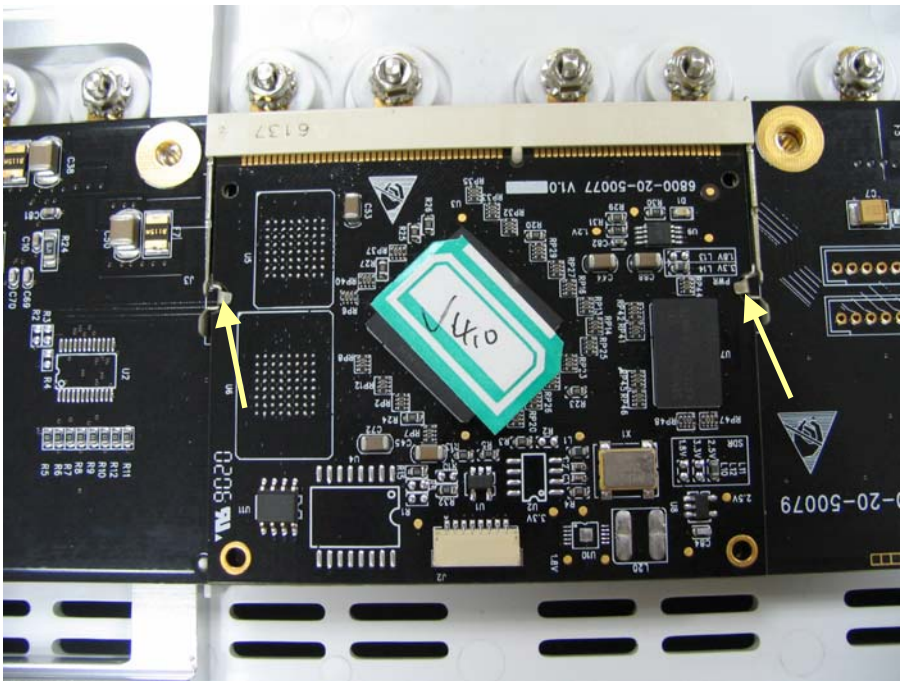


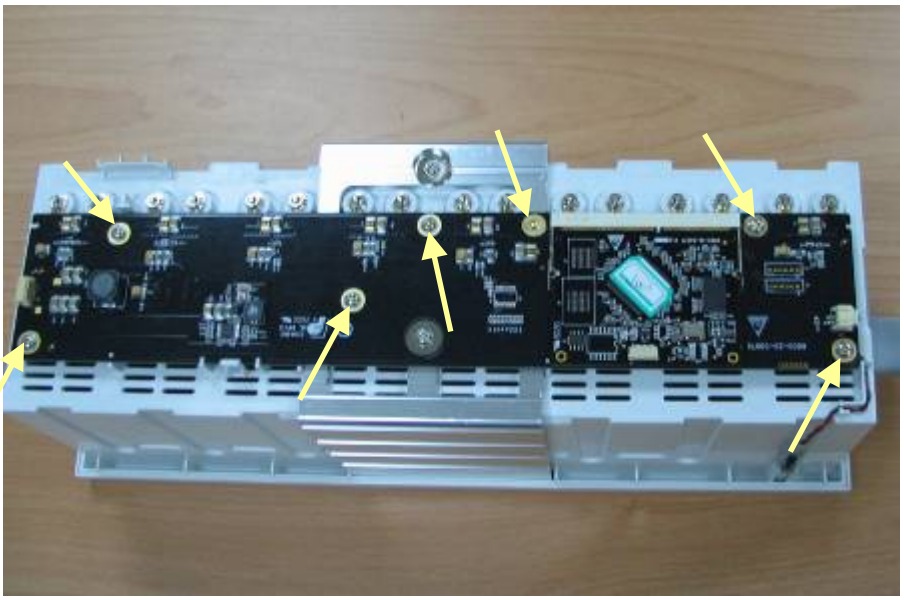
4. Release the two clips and take out the SMR interface board. Be sure not to damage the snap slot on the left side.



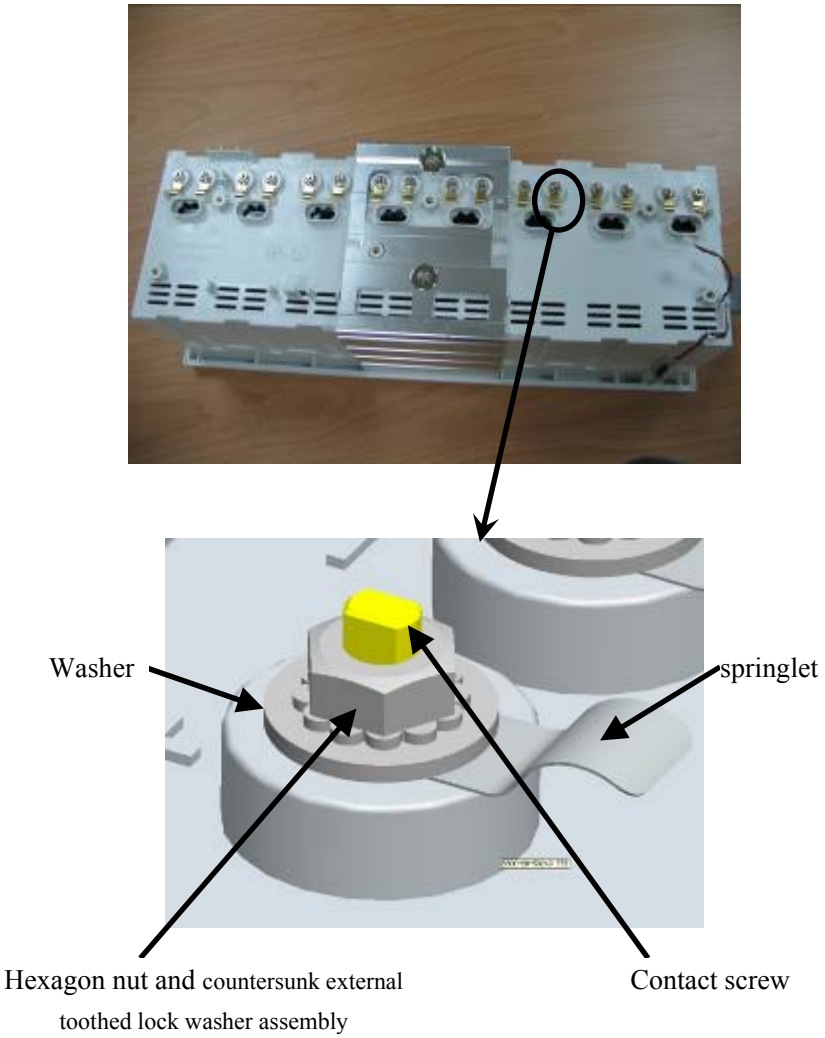
5. Remove the LED indicator, the light conductor and the cable that connects the SMR communication board and the LED board.

6. Release the clips and take out the Nios II module. Then unscrew the six M3×6 screws and remove the SMR communication board.





7. Use a socket wrench to unscrew the hexagon nut and countersunk external toothed lock washer assembly which can be further separated into the washer, springlet and contact screw.



5.5 Disassembling Modules

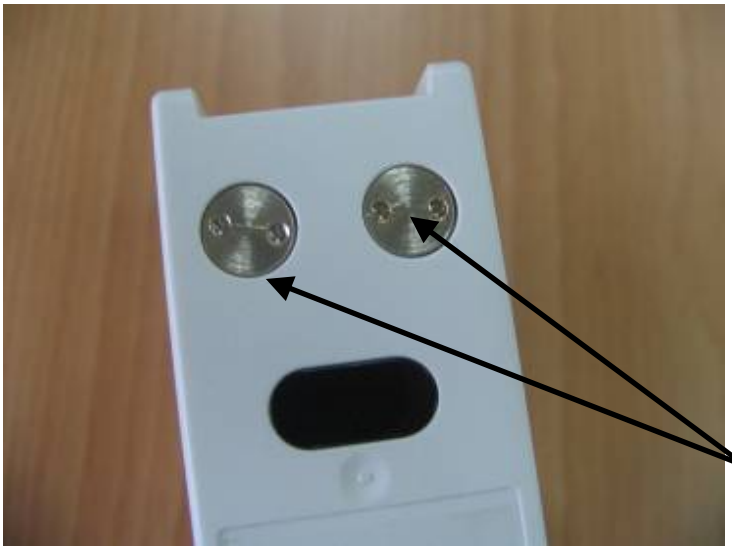
⚠WARNING

- **For a reassembled module, a patient leakage current test must be performed before it is used again for patient monitoring.**
- **Make sure the monitor is off before disassembling the modules.**

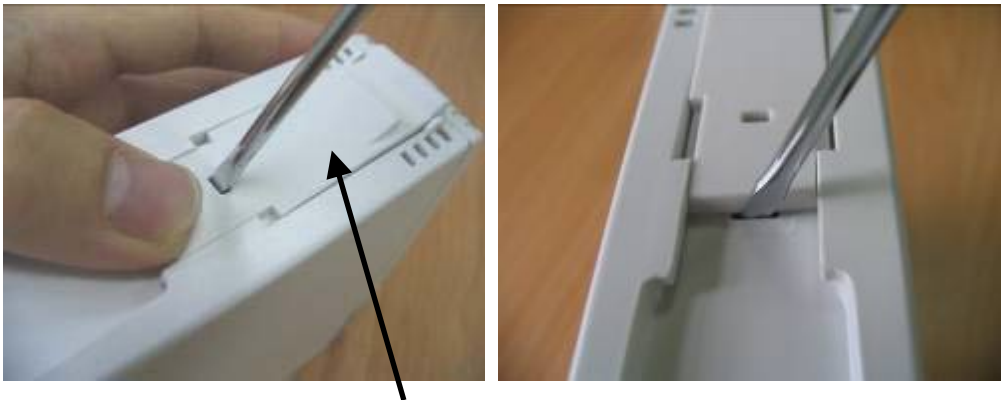
The monitor supports three types of modules, single-slot modules, 2-slot modules and 3-slot modules. The following part describes two typical disassembling procedures.

5.5.1 Disassembling the ICG Module

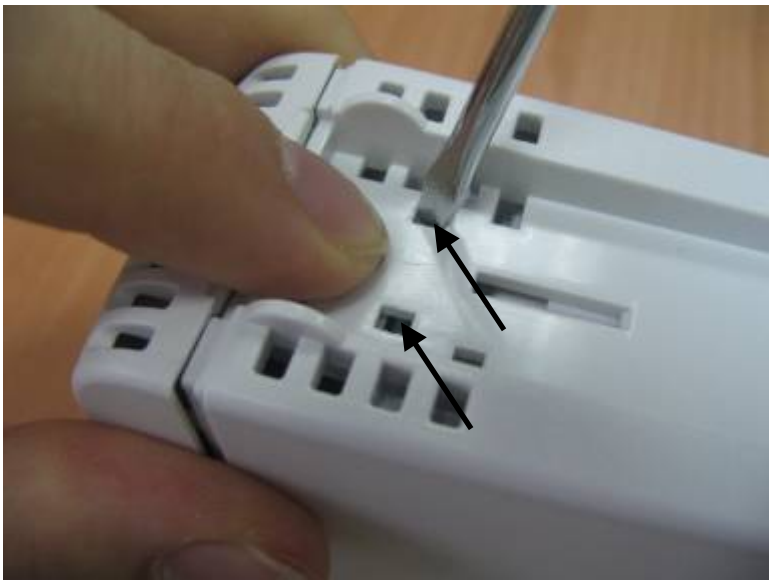
1. Unscrew the two contact screws and Φ3 spring washers on the back of the module with a dedicated contact spanner.



2. Unlock the snap close by pressing it down about 1 mm with a flat screwdriver. At same time, push the snap plate forward with your thumb until the snap close separate from its counterpart. Lift the snap plate with the flat screwdriver and remove it from the ICG module. In case the snap close relocks the snap plate when the end of the snap plate reaches the snap close, push the snap plate forward softly with the flat screwdriver.

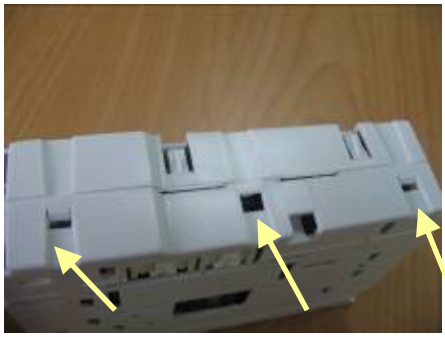


3. Unscrew the M3×6 screw. Then, press down, in turn, the two clips that engage the front panel. At same time, separate the front panel from the module's outer housing.



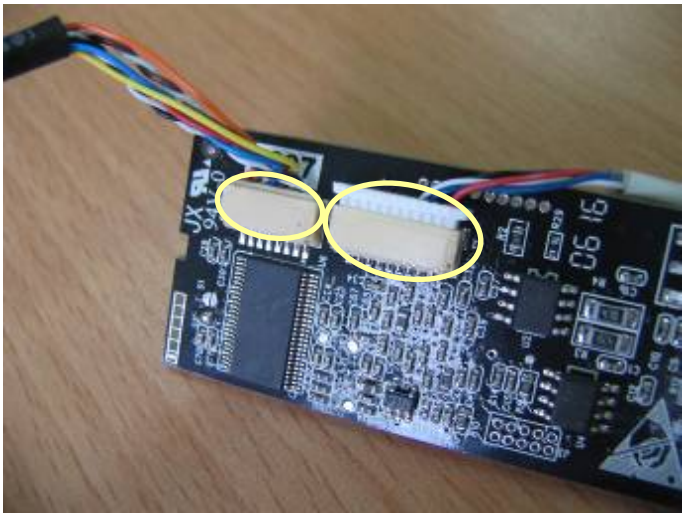
4. Remove the front panel carefully to avoid damaging the cables. The ICG module has an inner housing and an outer housing. Press the two clips on the inner housing about 1mm inwards to separate the inner and outer housing. Then, take off the outer housing.

5. The inner housing consists of a left and a right side cover. Release the three clips as shown in the figure below to separate the two side covers.

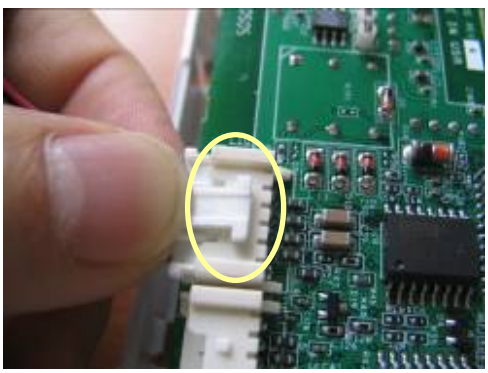


6. Take out the non-isolated power board and disconnect all the cables from it.

7. Take out the infrared communication board and disconnect all the cables from it.

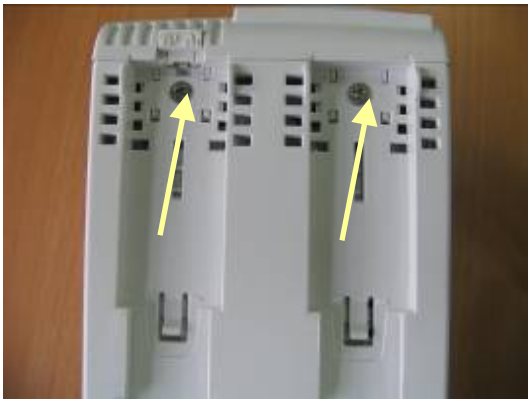


8. Disconnect all the cables from the PCBA and remove the front panel with cables on it.

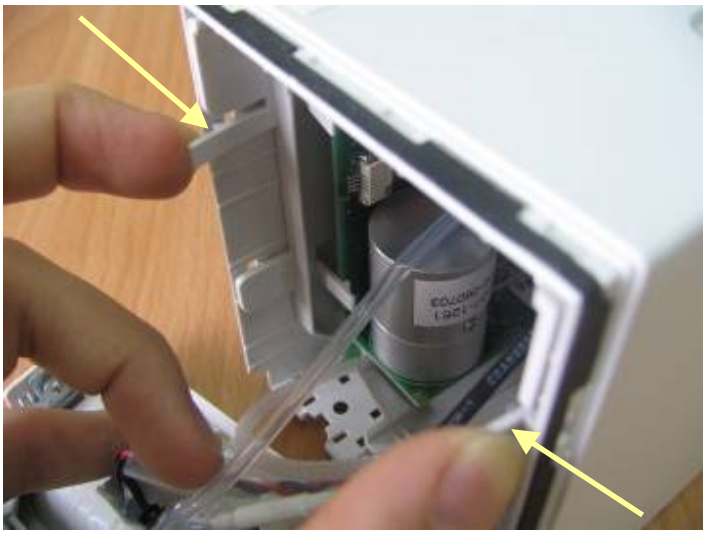


5.5.2 Disassembling CO_2 Module

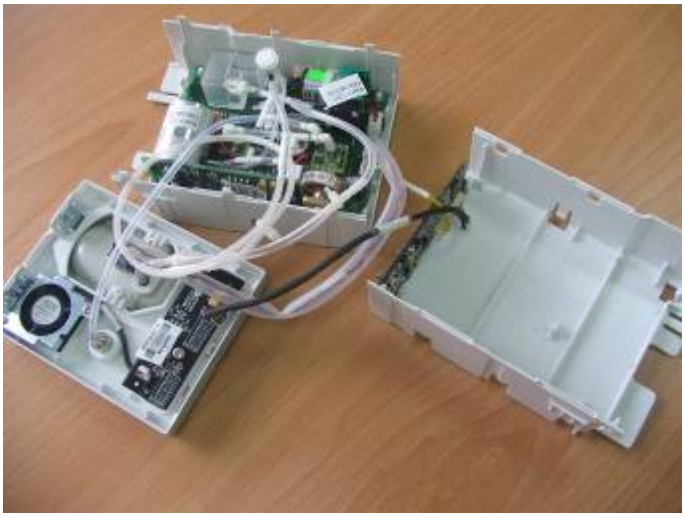
1. Remove the four contact screws on the back and the two snap plates at the bottom and then unscrew the two M3×6 screws by referring to the procedure as described in ***5.5.1 Disassembling the ICG Module***.



2. Remove the module's front panel by referring to the procedure as described in ***5.5.1 Disassembling the ICG Module***. Then, press the two clips on the inner housing about 1mm inwards to separate the inner and outer housing. Then, take off the outer housing.

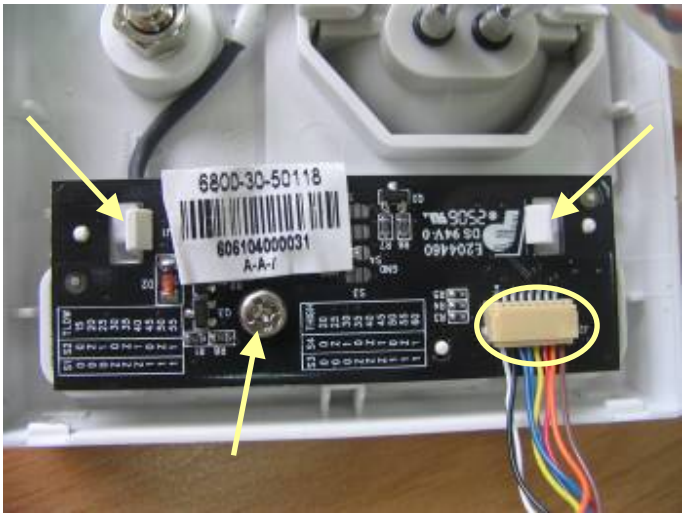


3. Hold the inner housing with both hands. Press the snap side with your thumb and push the other side with the index finger and the middle finger to separate the inner housing into two halves.

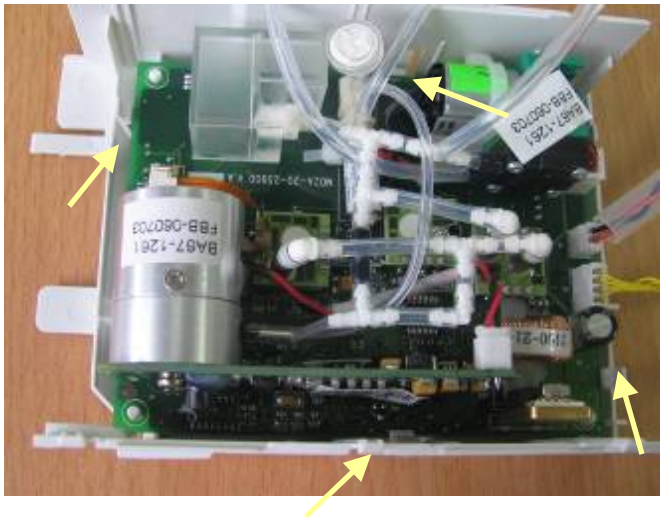


4. Remove the module infrared communication backboard and disconnect all the cables from it.

5. Disconnect the cables from the button board and unscrew the PT3×8 screw. Then release the two clips and take out the button board. After that, disconnect the cable to the fan and remove the button board.



6. Disconnect the tubing between the CO_2 parameter board and the front panel. Then release the four clips and remove the CO_2 parameter board.



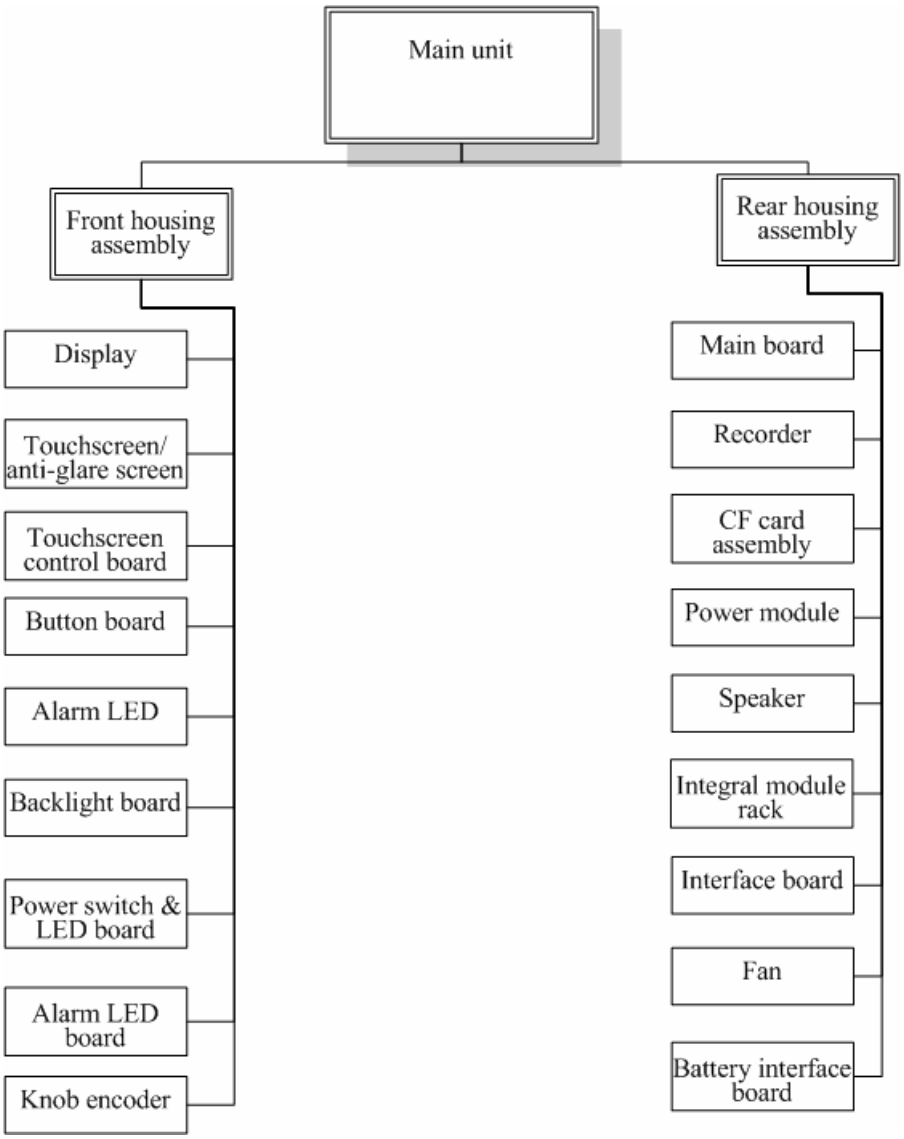
FOR YOUR NOTES

6 Parts

6.1 Introduction

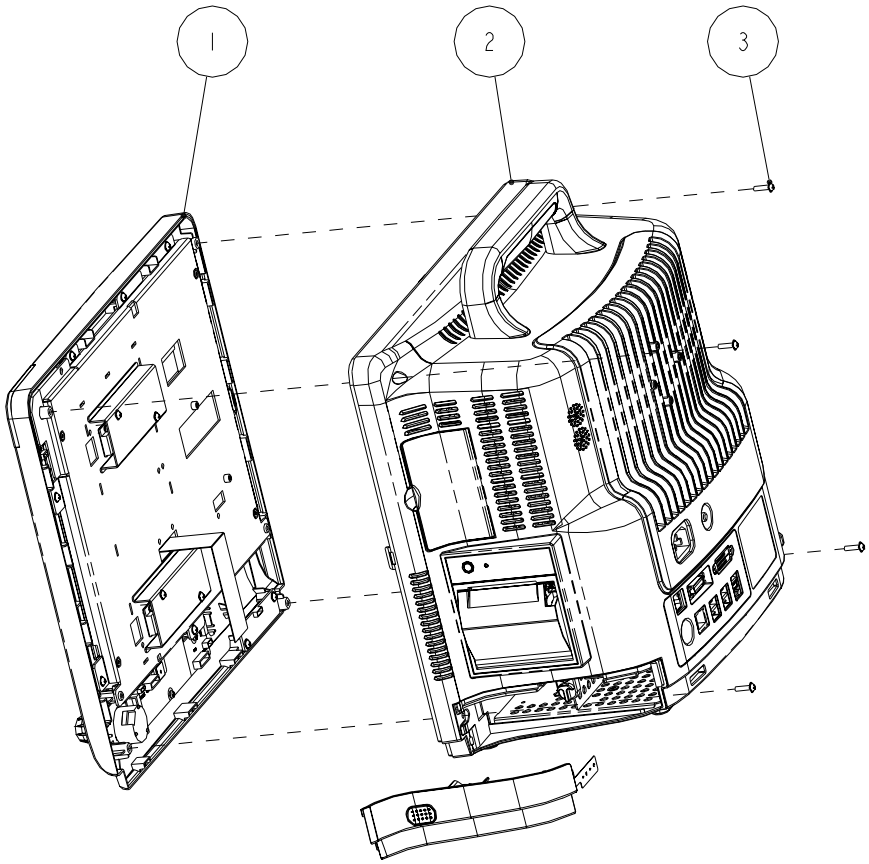
This chapter contains the exploded views and parts lists of the main unit, satellite module rack and the parameter modules of the patient monitor. It helps the engineers to identify the parts during disassembling the patient monitor and replacing the parts.

Hardware architecture of the main unit is shown below:



6.2 Main Unit

6.2.1 Exploded View



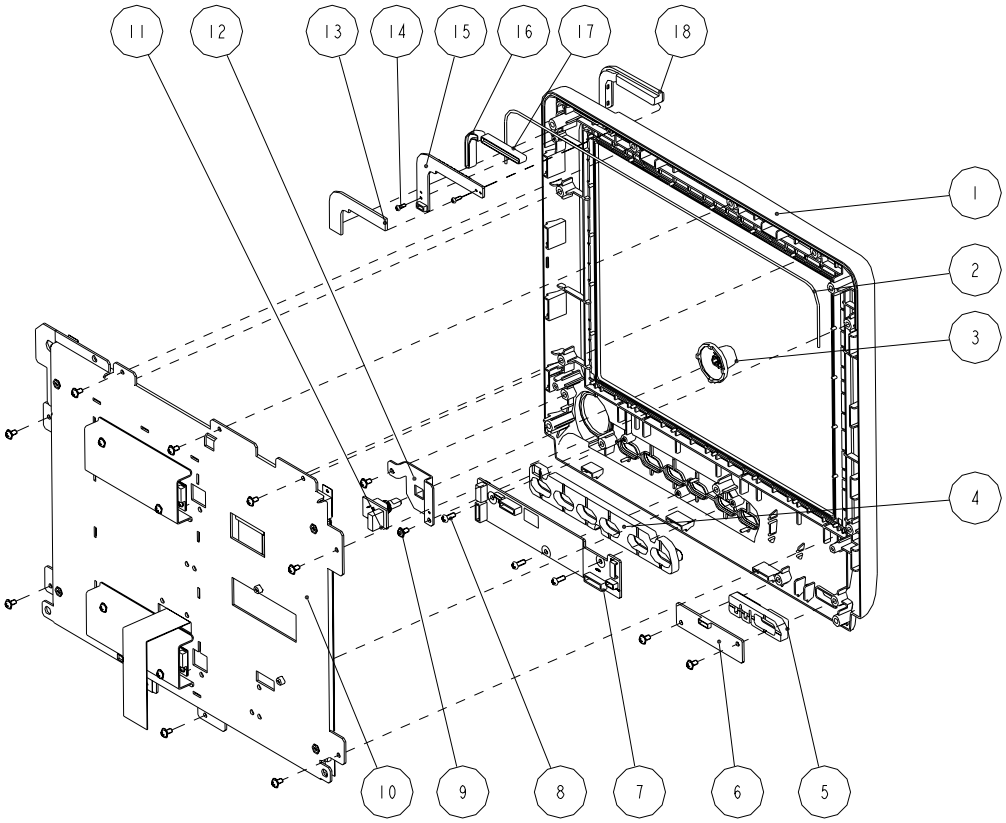
6.2.2 Parts List

SN	P/N	Description	Qty
1	6802-30-66761 or 6802-30-66762	Front housing assembly (with 12.1” LCD, anti-glare screen) Front housing assembly (with 12.1” LCD, touchscreen)	1
2	6802-30-66760	Main unit	1
3	M04-004017---	Crosshead screw M3X12	4

6.3 Front housing Assembly

6.3.1 12” LCD with Anti-glare Screen

Exploded View



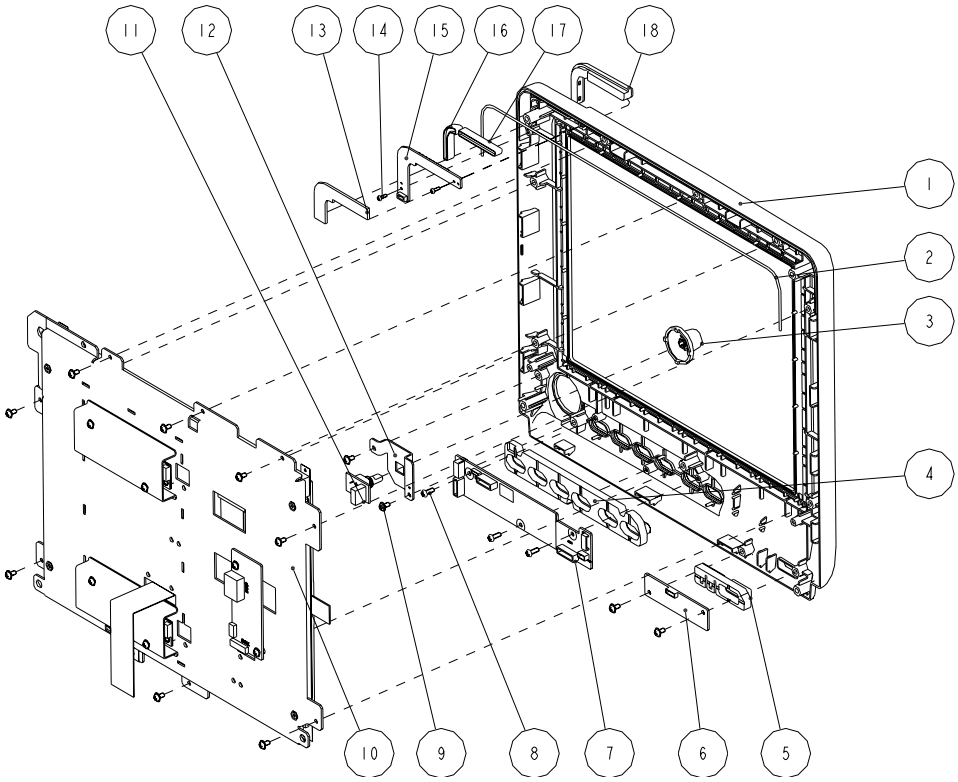
Parts List

SN	P/N	Description	Qty
1	6802-20-66687	Front bezel	1
2	M6G-020015---	Hose	1
3	9000-20-07354-52	Knob encoder	1
4	6800-20-50198	Key pad	1
5	6802-20-66691	Power key pad	1
6	6802-30-66680	Power switch & LED board	1
7	6802-30-66812	Button board	1

8	M04-003105---	Tapping screw PT3×8	3
9	M04-004012---	Crosshead screw M3X6	12
10	6802-30-66772	12.1" LCD assembly (anti-glare screen)	1
11	9200-30-10470	Encoder board	1
12	6800-20-50884	Encoder mounting board	1
13	6802-20-66729	Heat conductor for the LED cover	1
14	M04-051003---	Crosshead tapping screw PT2X6	2
15	6802-30-66682	LED board	1
16	6802-20-66690	Light conduction block 2	1
17	6802-20-66689	Light conduction block 1	1
18	6802-20-66688	Alarm LED cover	1

6.3.2 12” LCD with Touchscreen

Exploded View



Parts List

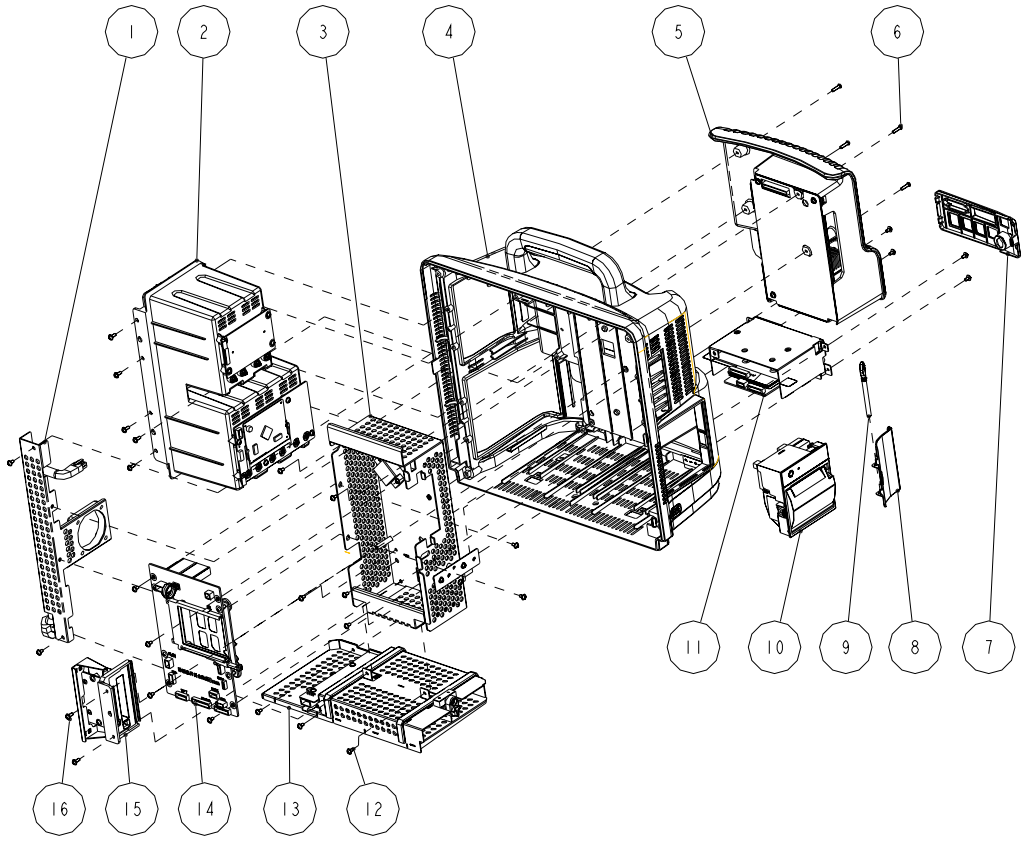
SN	P/N	Description	Qty
1	6802-20-66687	Front bezel	1
2	M6G-020015---	Hose	1
3	9000-20-07354-52	Knob encoder	1
4	6800-20-50198	Key pad	1
5	6802-20-66691	Power key pad	1
6	6802-30-66680	Power switch & LED board	1
7	6802-30-66812	Button board	1
8	M04-003105---	Tapping screw PT3×8	3
9	M04-004012---	Crosshead screw M3X6	12
10	6802-30-66773	12.1" LCD assembly (touchscreen)	1
11	9200-30-10470	Encoder board	1

12	6800-20-50884	Encoder mounting board	1
13	6802-20-66729	Heat conductor for the LED cover	1
14	M04-051003---	Crosshead tapping screw PT2X6	2
15	6802-30-66682	LED board	1
16	6802-20-66690	Light conduction block 2	1
17	6802-20-66689	Light conduction block 1	1
18	6802-20-66688	Alarm LED cover	1

6.4 Main Unit

6.4.1 Main Unit Assembly

Exploded View



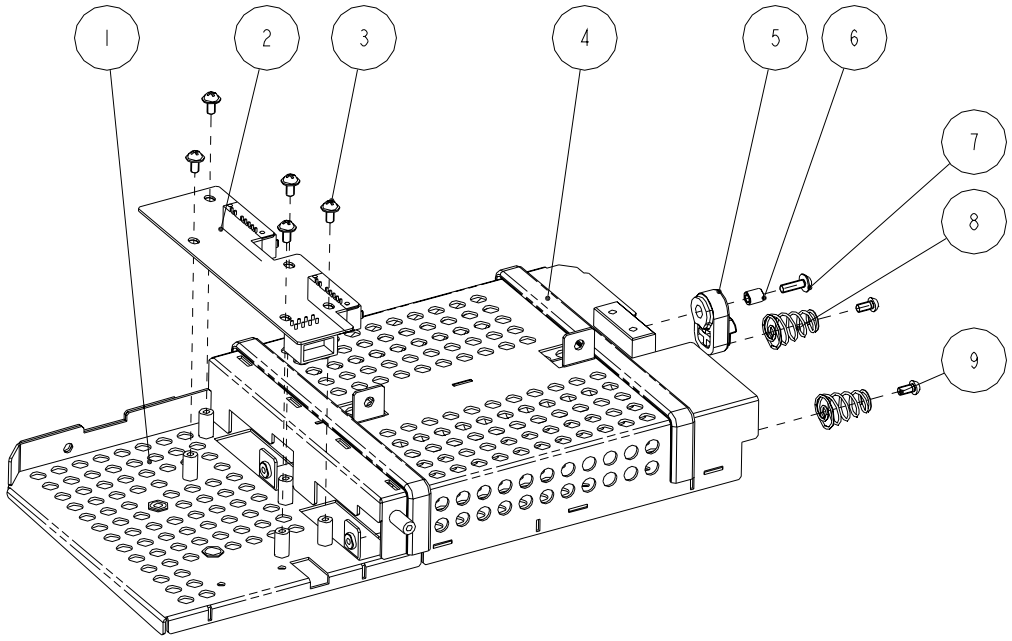
Parts List

SN	P/N	Description	Qty
1	6802-30-66768	Fan assembly	1
2	6802-30-66765	Integral module rack	1
3	6802-30-66794	Main support assembly	1
4	6802-30-66766	Rear housing assembly	1
5	6802-30-66770	Power module assembly	1
6	M04-051014---	Crosshead screw M3X12	4
7	6802-20-66712	Interface board cover	1

8	6802-20-66707	CF card door	1
9	6800-20-50398	WLAN card pushing rod	1
10	TR6F-30-67306	TR6F recorder	1
11	6802-30-66769	Interface board assembly	1
12	M04-004012---	Crosshead screw M3X6	20
13	6802-30-66763	Battery compartment assembly	1
14	6802-30-66767	Main board assembly	1
15	6802-30-66771	CF card assembly	1
16	M04-004015---	Crosshead screw M3X8	7

6.4.2 Battery Compartment Assembly

Exploded View

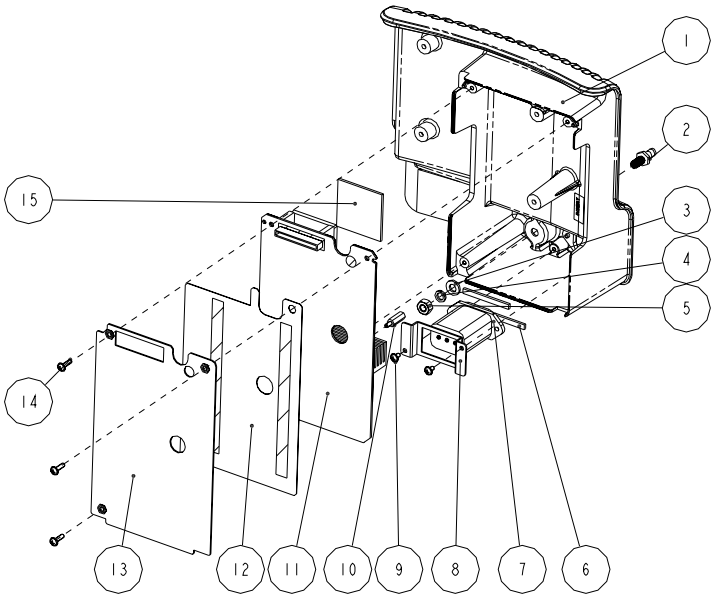


Parts List

SN	P/N	Description	Qty
1	6802-20-66714	Battery compartment	1
2	6802-30-66653	Battery interface board	1
3	M04-004012---	Crosshead screw M3X6	5
4	M6T-030008---	Conducting block 9.5X3.2	2
5	6802-20-66715	Battery latch	1
6	6802-20-66798	Battery latch fixture	1
7	M04-004013---	Crosshead screw M3X10	1
8	DA8K-20-27052	Spring	2
9	M04-002505---	Crosshead screw M3X6	2

6.4.3 Power Module assembly

Exploded View

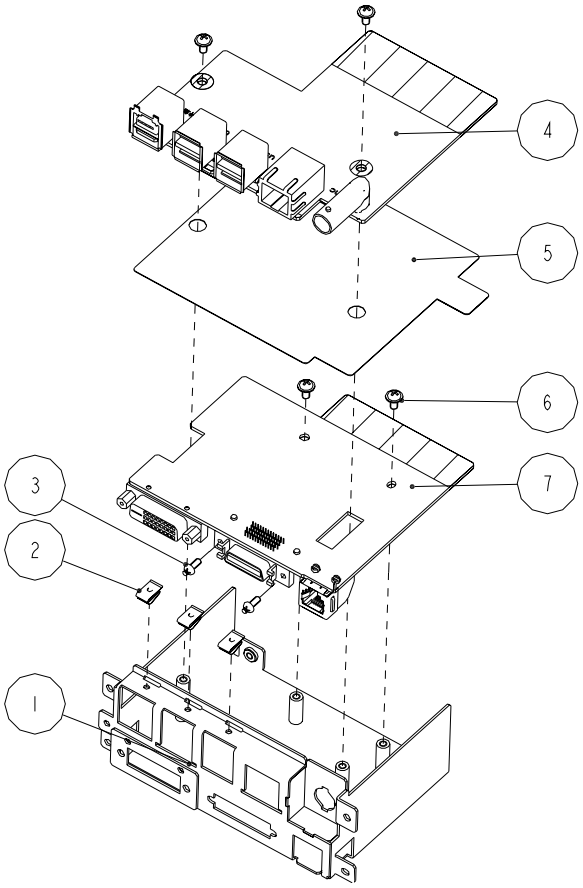


Parts List

SN	P/N	Description	Qty
1	6802-20-66719	Power supply compartment	1
2	0509-20-00098	Grounding pole	1
3	M04-021003---	Flat washer, GB97.1 6	1
4	M04-004504---	Spring washer, GB93 6	1
5	M04-004401---	Stainless steel nut, GB6170 M6	1
6	6800-20-50636	Waterproof strip for power socket	2
7	6800-21-50337	AC input filter cable	1
8	6800-20-50218	power socket fixture	1
9	M04-004012---	Crosshead screw M3X6	2
10	M90-000136---	Plastic double-ended bolt M3X15+6-8	1
11	6802-30-66651	Power board	1
12	6802-20-66721	Insulating plate	1
13	6802-20-66720	Power supply cover	1
14	M04-004017---	Crosshead screw M3X12	3
15	6802-20-66796	Power board heat conductor	1

6.4.4 Interface Board Assembly

Exploded View

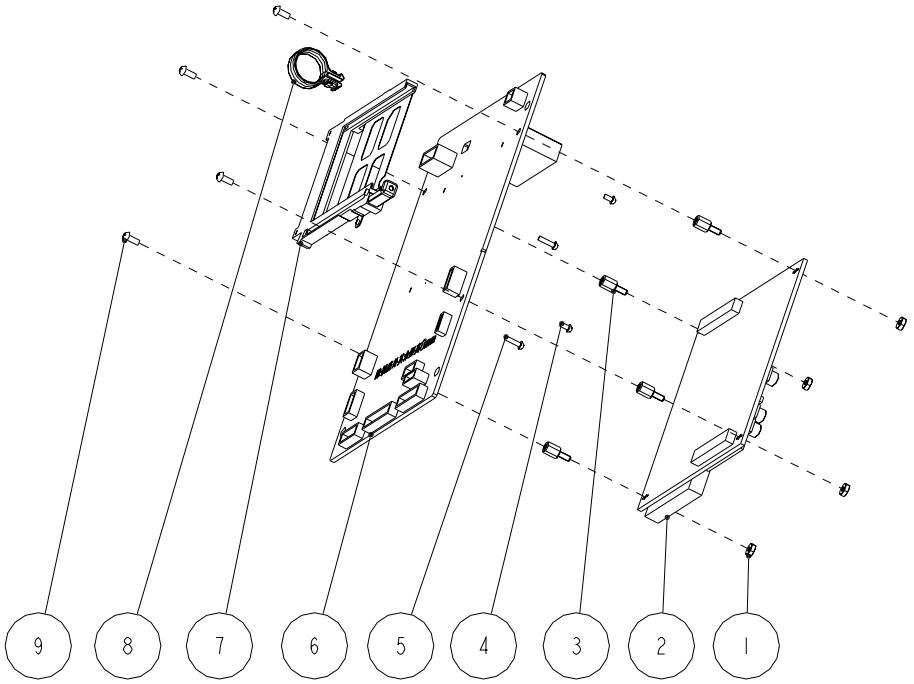


Parts List

SN	P/N	Description	Qty
1	6802-20-66713	Interface board frame	1
2	M6T-030006---	Leaf	3
3	M04-051045---	Crosshead screw M2.5X6	2
4	6802-30-66659	USB_Hub board	1
5	6802-20-66754	Interface board insulating plate	1
6	M04-004012---	Crosshead screw M3X6	4
7	6802-30-66657	DVI interface board	1

6.4.5 Main Board Assembly

Exploded View

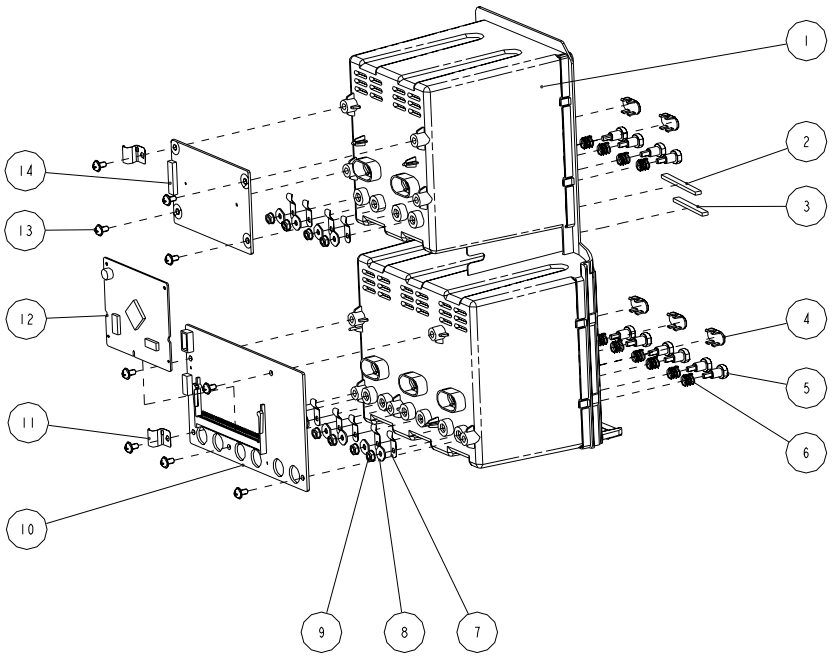


Parts List

SN	P/N	Description	Qty
1	M04-011001---	Nut, GB6170 M2.5	4
2	6800-30-50058	Main board CPU	1
3	M04-060021---	Screw M2.5x7+6-6	4
4	M04-051137---	Crosshead screw M2X4	2
5	M04-000805---	Crosshead screw M2X8	2
6	6802-30-66655	Mother board	1
7	M39-000217---	WLAN socket	1
8	6802-20-66724	PCB handle	1
9	M04-051045---	Crosshead screw M2.5X6	4

6.4.6 Integral module rack

Exploded View

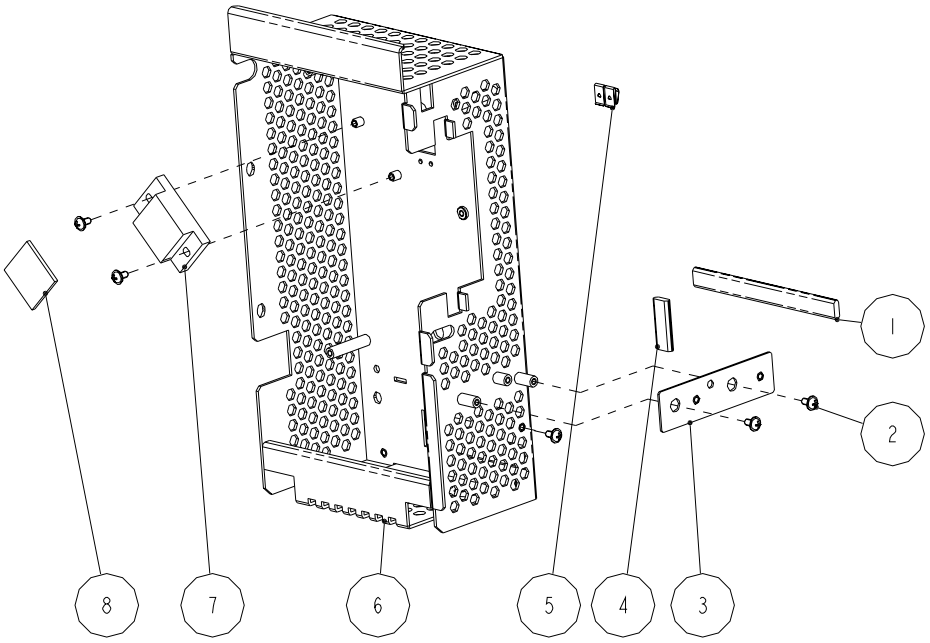


Parts List

SN	P/N	Description	Qty
1	6802-20-66709	Integral module rack	1
2	6802-20-66817	Waterproof strip 2 for integral module rack	1
3	6802-20-66816	Waterproof strip 1 for integral module rack	1
4	6800-20-50279	Infrared light filter	5
5	6800-20-50258	Contact screw	10
6	6800-20-50261	Contact spring	10
7	6800-20-50388	Leaf	10
8	M04-021024---	Flat washer, GB96 3	10
9	M04-011002---	M3 nut with spring washer	10
10	6802-30-66676	3-slot communication board	1
11	6802-20-66710	Grounding leaf	2
12	6800-30-50075	Nios II module	1
13	M04-004012---	Crosshead screw M3X6	9
14	6800-30-50073	MPM module rack communication board	1

6.4.7 Main Support Assembly

Exploded View

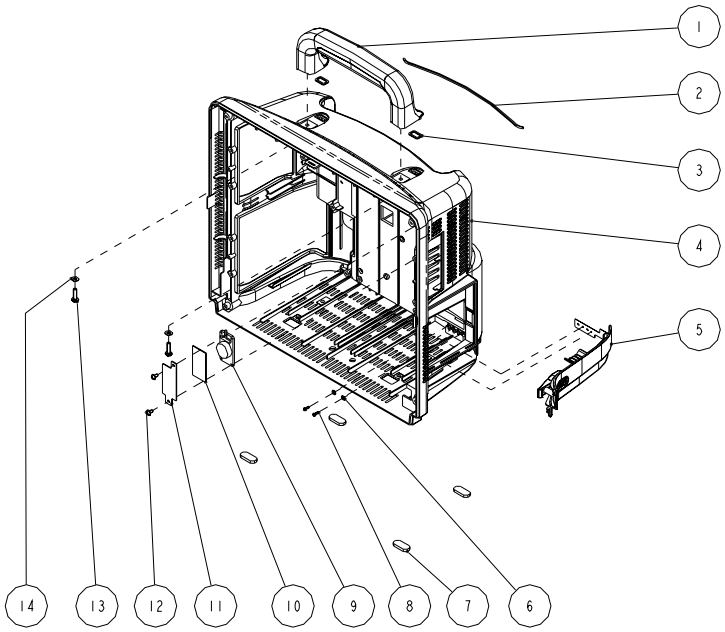


Parts List

SN	P/N	Description	Qty
1	M6T-030008---	Conducting block 9.5X3.2	1
2	M04-004012---	Crosshead screw M3X6	5
3	6802-20-66718	Recorder fixing plate	1
4	M6T-030008---	Conducting block 9.5X3.2	1
5	M6T-030006---	Leaf	2
6	6802-20-66717	Main support	1
7	6802-20-66789	CPU radiator	1
8	6802-20-66793	CPU heat conductor	1

6.4.8 Rear Housing Assembly

Exploded View

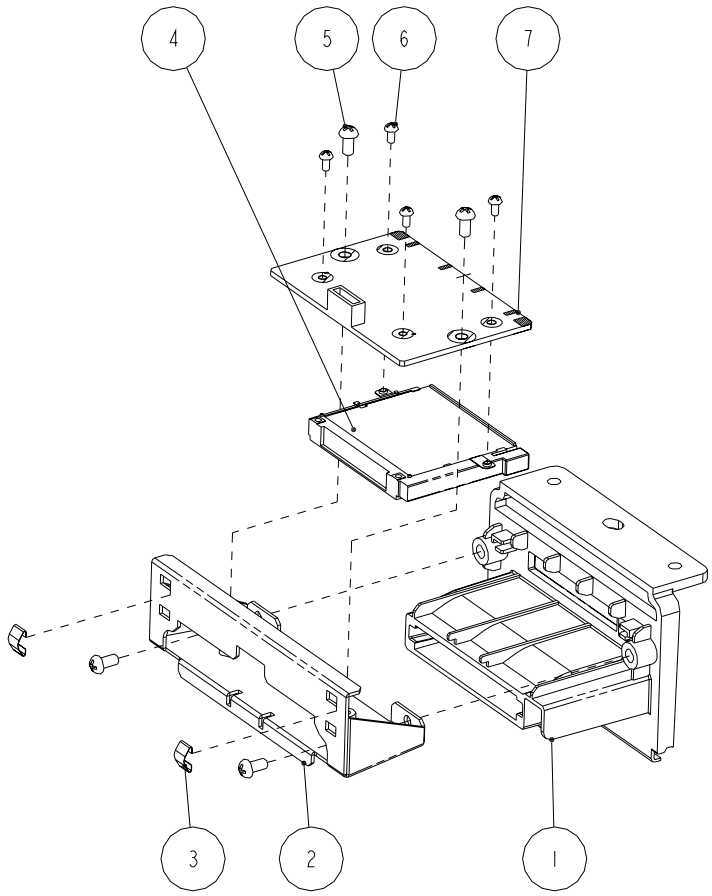


Parts List

SN	P/N	Description	Qty
1	6802-20-66699	Handle	1
2	6802-20-66737	Waterproof strip for the power supply	1
3	6802-20-66736	Handle waterproof pad	2
4	6802-20-66698	Rear housing	1
5	6802-30-66764	Battery door assembly	1
6	M04-021000---	Flat washer, GB97.1 2.5	2
7	6800-20-50233	Cushion	4
8	M04-051003---	Crosshead tapping screw PT2X6	2
9	6802-20-66668	Speaker and cables	1
10	8002-20-36218	Speaker spacer	1
11	6802-20-66791	Speaker cover	1
12	M04-004012---	Crosshead screw M3X6	2
13	M04-051085---	Tapping screw PT4X14	2
14	M04-004702---	Flat washer, GB97.1 4	2

6.4.9 CF Card Assembly

Exploded View

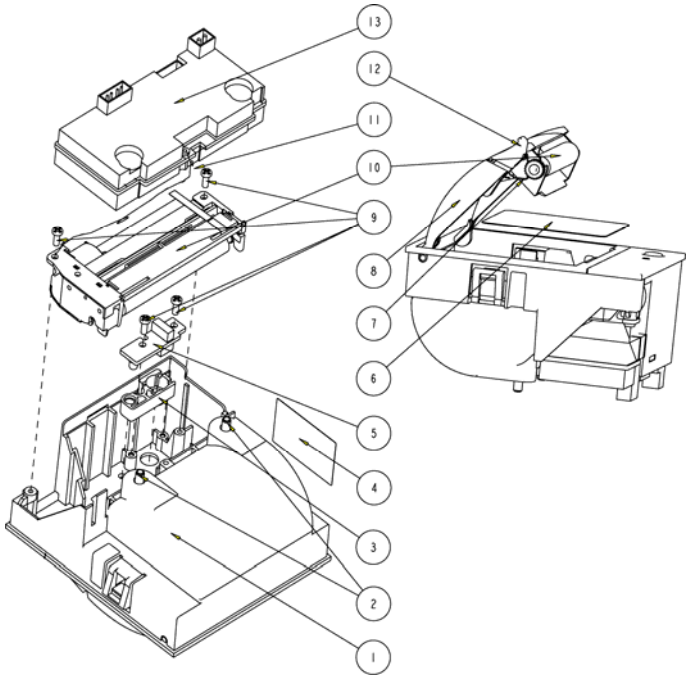


Parts List

SN	P/N	Description	Qty
1	6802-20-66725	Card cover	1
2	6802-20-66726	CF card board fixture	1
3	M6T-030005---	Leaf, 178S30(1EA=406mm)	2
4	M39-000234---	Ejector for CF card socket (50pin)	1
5	M04-002505---	Crosshead screw M3X6	4
6	M04-051137---	Crosshead screw M2X4	4
7	6802-30-66678	CF card board	1

6.4.10 Recorder Assembly

Exploded View



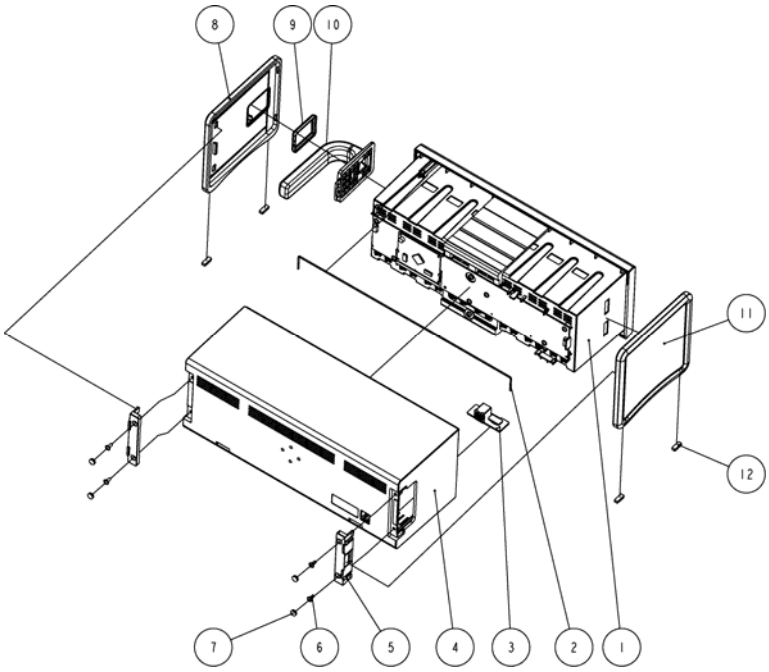
Parts List

SN	P/N	Description	Qty
1	TR6F-20-67300	Recorder chamber	1
2	M04-004012---	Crosshead screw M3×6	2
3	TR6F-20-67305	Key pad	1
4	PRIA-20-13639	Probe cable label	1
5	TR6F-30-67308	Button board for the recorder	1
6	TR6F-20-67307	Recorder overlay	1
7	TR6F-20-67304	Back spring	1
8	TR6F-20-67301	Recorder door	1
9	M04-002405---	Crosshead screw M2×6	4
10	0000-10-11079	Thermal print head	1
11	9201-20-36007	Recorder grounding wire	1
12	TR6F-20-67302	Recorder door handle	1
13	TR6F-30-67310	Recorder driving board	1

6.5 SMR

6.5.1 SMR Assembly

Exploded View

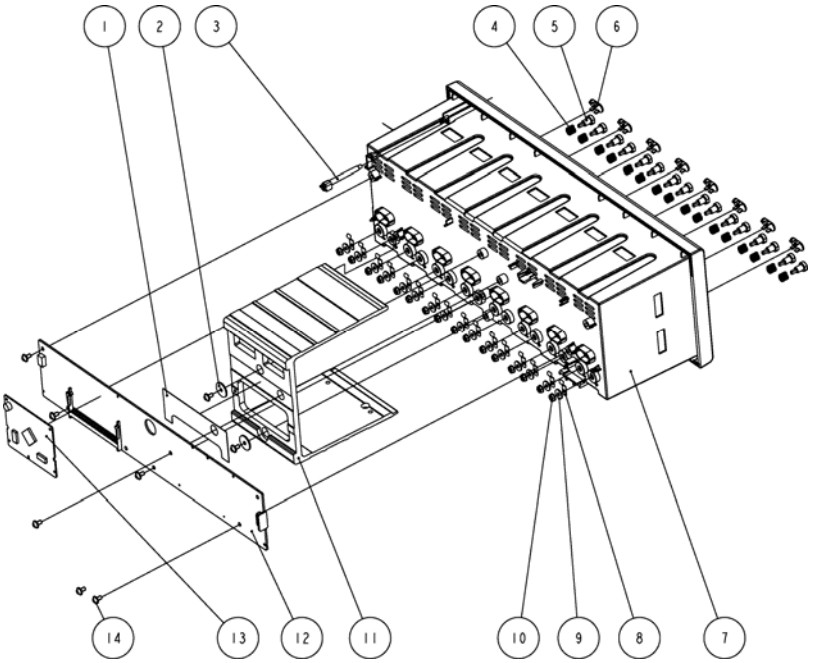


Parts List

SN	P/N	Description	Qty
1	6800-20-50249-51	SMR inside assembly	1
2	M6G-020015---	Hose	1
3	6800-30-50080	SRM Interface board	1
4	6800-20-50250	SRM Rear housing	1
5	6800-20-50254	Side plate fixture	2
6	M04-004015---	Crosshead screw M3×8	4
7	6800-20-50308	Screw cap 2	4
8	6800-20-50253	Side plate, right	1
9	6800-20-50262	Rubber washer	1
10	6800-20-50251	SMR handle	1
11	6800-20-50252	Side plate, left	1
12	6800-20-50263	Cushion	4

6.5.2 SMR Inside Assembly

Exploded View



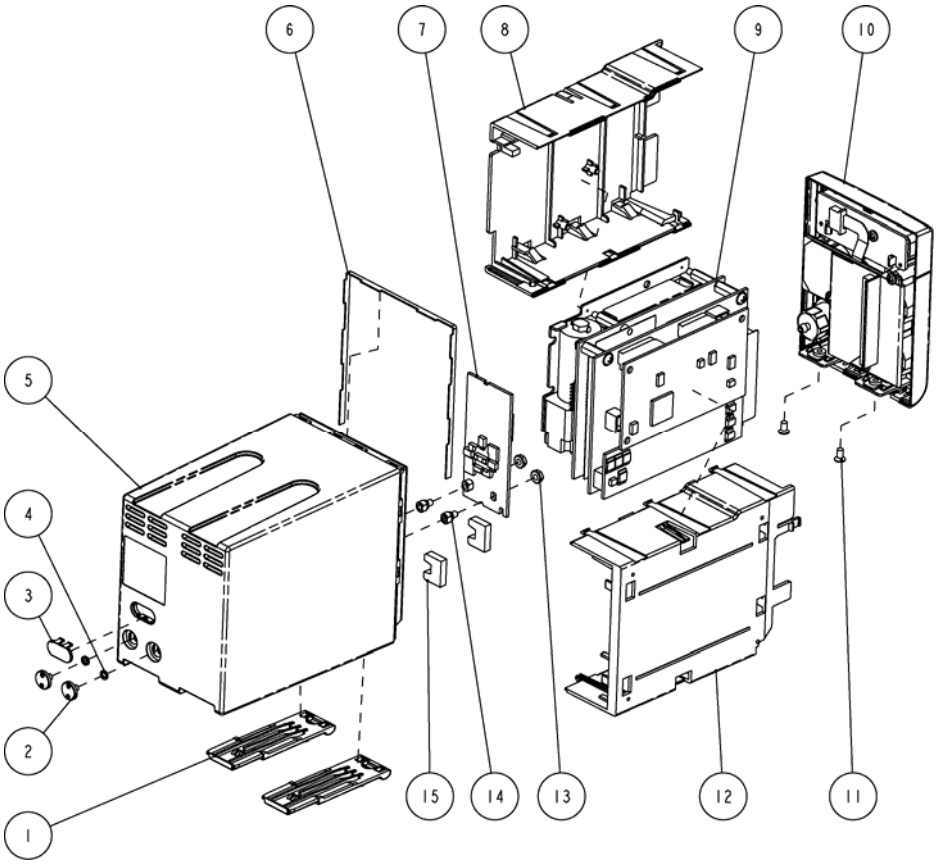
Parts List

SN	P/N	Description	Qty
1	6800-20-50519	Insulating plate	1
2	9201-20-36010	Torsion spring washer	2
3	6800-20-50256	Light conducting pole	1
4	6800-20-50261	Contact spring	16
5	6800-20-50258	Contact screw	16
6	6800-20-50279	Infrared light filter	8
7	6800-20-50249-51	SMR inside assembly	1
8	6800-20-50388	Leaf	16
9	M04-021024---	Washer	16
10	M04-011002---	Hex nut assy	16
11	6800-20-50257-51	Reinforced section steel	1
12	6800-30-50078	SMR communication board	1
13	6800-30-50075	Nios II module	1
14	M04-004012---	Crosshead screw M3×6	8

6.6 Parameter Modules

6.6.1 MPM Module

Exploded View



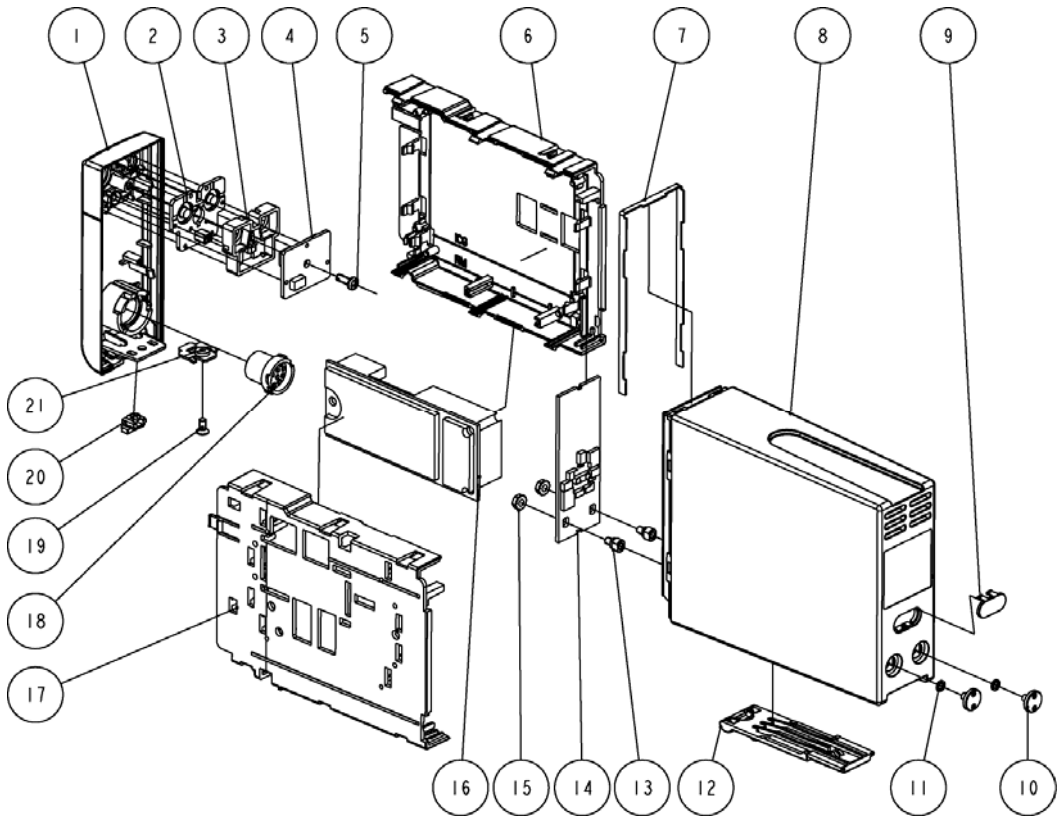
Parts List

SN	P/N	Description	Qty
1	6800-20-50278	Snap plate	2
2	6800-20-50293	Screw	2
3	6800-20-50279	Infrared light filter	1
4	M04-000104---	Spring washer	2
5	6800-20-50273	2-slot module rear housing	1
6	6800-20-50339	Waterproof seal 02	1
7	6800-30-50684	MPM infrared communication backboard	1

8	6800-20-50275	2-slot module inner housing, right side	1
9	6800-30-50499	NIBP module	1
10	6800-20-50272	MPM front panel assembly	1
11	M04-005005---	Crosshead screw M3×6	2
12	6800-20-50274	2-slot module inner housing, left side	1
13	M04-011002---	M3 nut with spring washer	2
14	6800-20-50292	Fixer	2
15	6800-20-50870	Cushion	2

6.6.2 C.O. Module

Exploded View

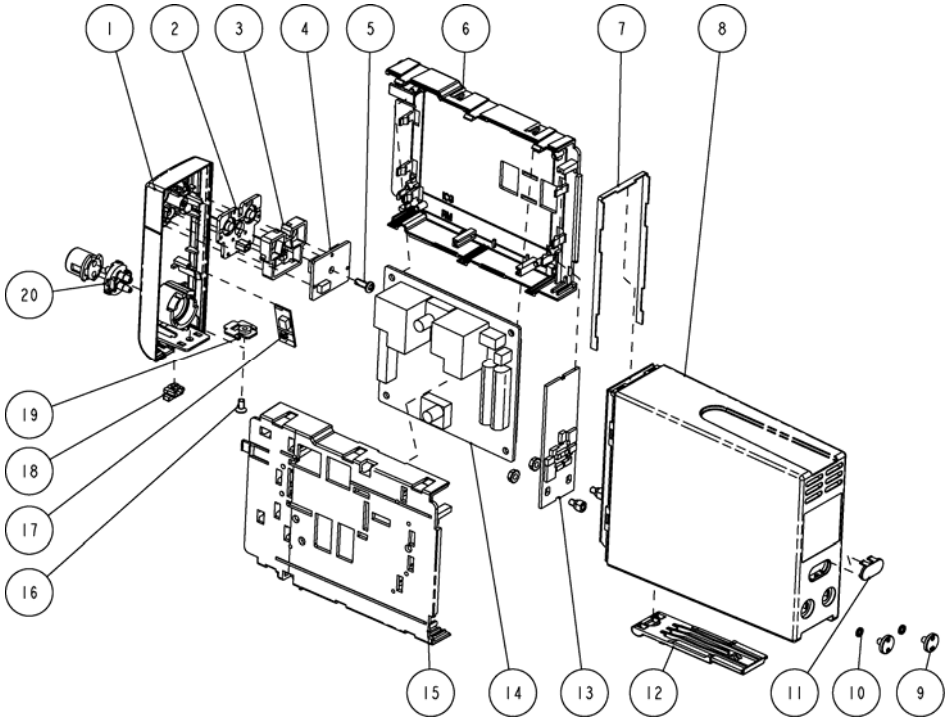


Parts List

SN	P/N	Description	Qty
1	6800-20-50264	Single-slot module front panel	1
2	6800-20-50284	Key pad for single-slot module	1
3	6800-20-50282	Key pad fixture for single-slot module	1
4	6800-30-50114	Button board for Single-slot module	1
5	M04-003105---	Tapping screw PT3×8	1
6	6800-20-50269	Single-slot module inner housing, left side	1
7	6800-20-50338	Waterproof seal 01	1
8	6800-20-50268	Single-slot module rear housing	1
9	6800-20-50279	Infrared light filter	1
10	6800-20-50293	Screw	2
11	M04-000104---	Spring washer	2
12	6800-20-50278	Snap plate	1
13	6800-20-50292	Fixer	2
14	6800-30-50097	Module infrared communication backboard	1
15	M04-011002---	M3 nut with spring washer	2
16	M03a-30-26058	IBP board	1
17	6800-20-50270	Single-slot module inner housing, right side	1
18	6800-20-50101	C.O. connector	1
19	M04-005005---	Crosshead screw M3×6	1
20	6800-20-50394	Snap close	1
21	6800-20-50286	Locking device	1

6.6.3 RM Module

Exploded View



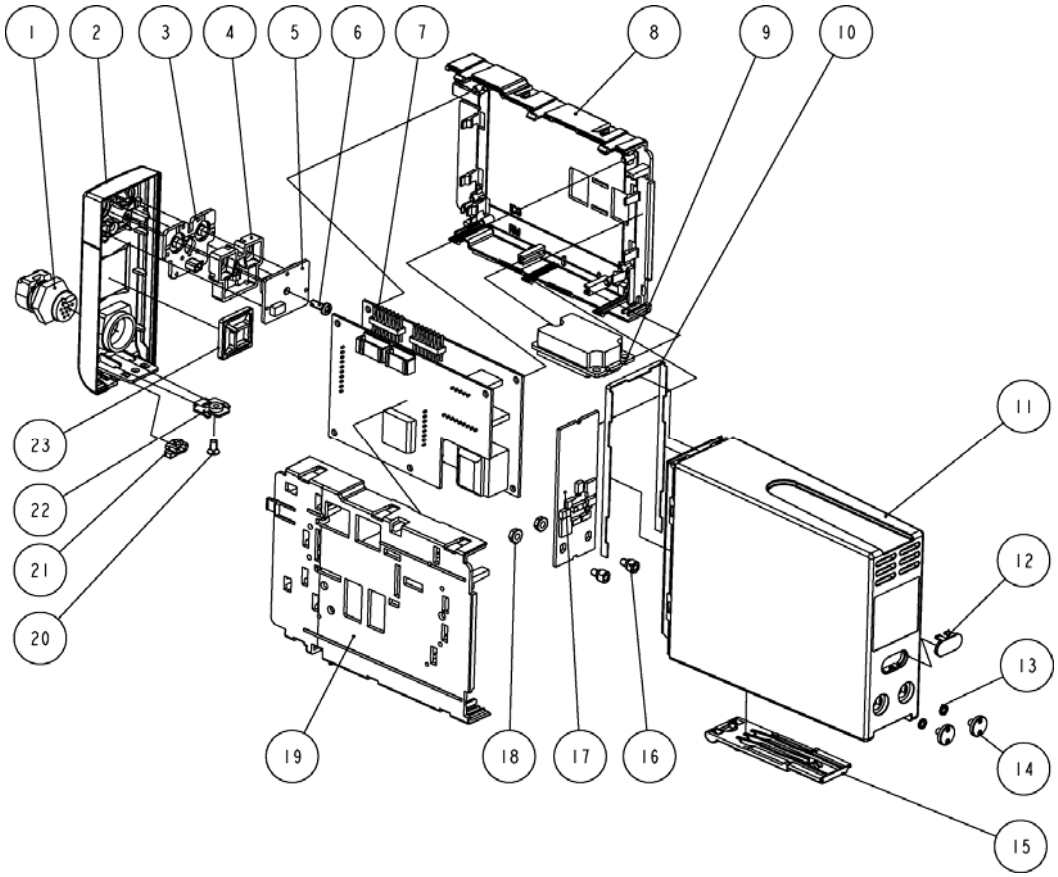
Parts List

SN	P/N	Description	Qty
1	6800-20-50264	Single-slot module front panel	1
2	6800-20-50284	Key pad for single-slot module	1
3	6800-20-50282	Key pad fixture for single-slot module	1
4	6800-30-50114	Button board for Single-slot module	1
5	M04-003105---	Tapping screw PT3×8	1
6	6800-20-50269	Single-slot module inner housing, left side	1
7	6800-20-50338	Waterproof seal 01	1
8	6800-20-50268	Single-slot module rear housing	1
9	6800-20-50293	Screw	2
10	M04-000104---	Spring washer	2
11	6800-20-50279	Infrared light filter	1
12	6800-20-50278	Snap plate	1

13	6800-30-50097	Module infrared communication backboard	1
14	M04a-30-58451	RM module PCB assembly	1
15	6800-20-50270	Single-slot module inner housing, right side	1
16	M04-005005---	Crosshead screw M3×6	1
17	6800-30-50152	RM module infrared detecting board	1
18	6800-20-50394	Snap close	1
19	6800-20-50286	Locking device	1
20	6800-30-50489	RM connector assembly	1

6.6.4 ICG Module

Exploded View

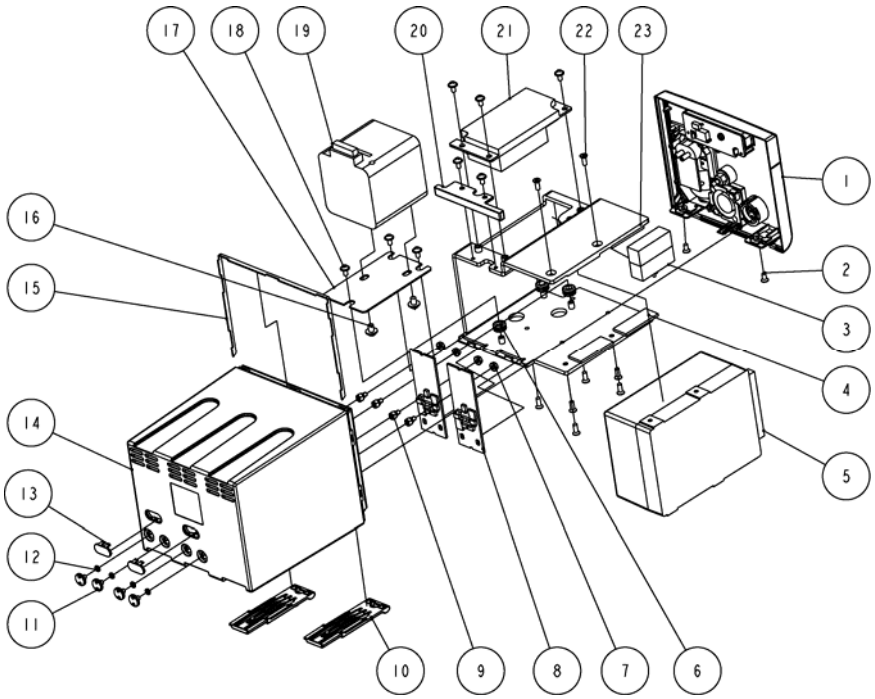


Parts List

SN	P/N	Description	Qty
1	0010-10-42826	ICG module signal wire	1
2	6800-20-50266	Single-slot module front panel	1
3	6800-20-50284	Key pad for single-slot module	1
4	6800-20-50282	Key pad fixture for single-slot module	1
5	6800-30-50114	Button board for Single-slot module	1
6	M04-003105---	Tapping screw PT3×8	1
7	0010-10-42826	ICG module PCB assembly	1
8	6800-20-50269	Single-slot module inner housing, left side	1
9	6800-30-50094	Non isolating power board	1
10	6800-20-50338	Waterproof seal 01	1
11	6800-20-50268	Single-slot module rear housing	1
12	6800-20-50279	Infrared light filter	1
13	M04-000104---	Spring washer	2
14	6800-20-50293	Screw	2
15	6800-20-50278	Snap plate	1
16	6800-20-50292	Fixer	2
17	6800-30-50097	Module infrared communication backboard	1
18	M04-011002---	M3 nut with spring washer	2
19	6800-20-50270	Single-slot module inner housing, right side	1
20	M04-005005---	Crosshead screw M3×6	1
21	6800-20-50394	Snap close	1
22	6800-20-50286	Locking device	1
23	M39-059004---	Wire fixture	1

6.6.5 AG Module

Exploded View



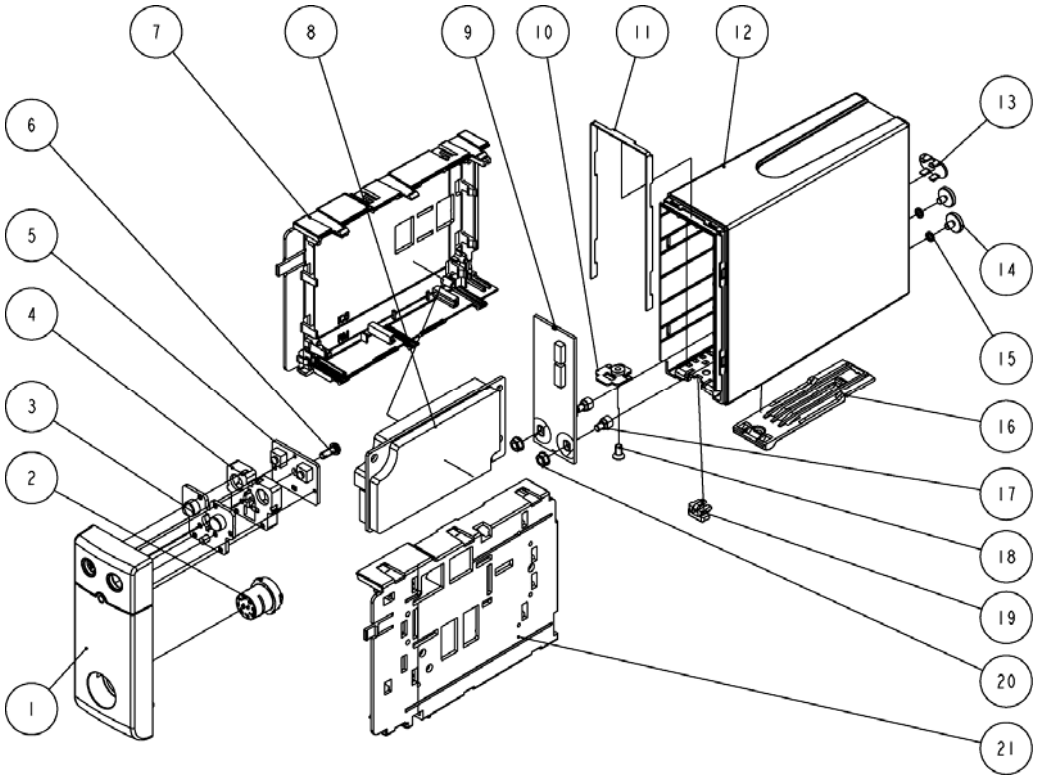
Parts List

SN	P/N	Description	Qty
1	6800-30-50539	AG front panel assembly（with BIS）	1
2	M04-005005---	Crosshead screw M3×6	2
3	9200-21-10605	AG module box	1
4	6800-20-50290	Aluminium support rack	1
5	9200-10-10529	AG module	1
6	M39-000046---	TIE MOUNT	3
7	M04-011002---	M3 nut with spring washer	4
8	6800-30-50097	Module infrared communication backboard	2
9	6800-20-50292	Fixer	4
10	6800-20-50278	spanner	2
11	6800-20-50293	screw	4
12	M04-000104---	Spring washer	4
13	6800-20-50279	Infrared light filter	2

14	6800-20-50277	AG module rear housing	1
15	6800-20-50340	Waterproof seal 03	1
16	M04-006512---	Crosshead screw M4×6	2
17	6800-20-50291	O_2 module mount	1
18	M04-004012---	Crosshead screw M3×6	8
19	9200-10-10531	O_2 module	1
20	6800-20-50281	Infrared communication backboard support rack	1
21	6800-30-50092	Isolating power board	1
22	M04-000405---	Crosshead screw M3×8	8
23	6800-20-50699	AG module insulating pad	4

6.6.6 BIS Module

Exploded View

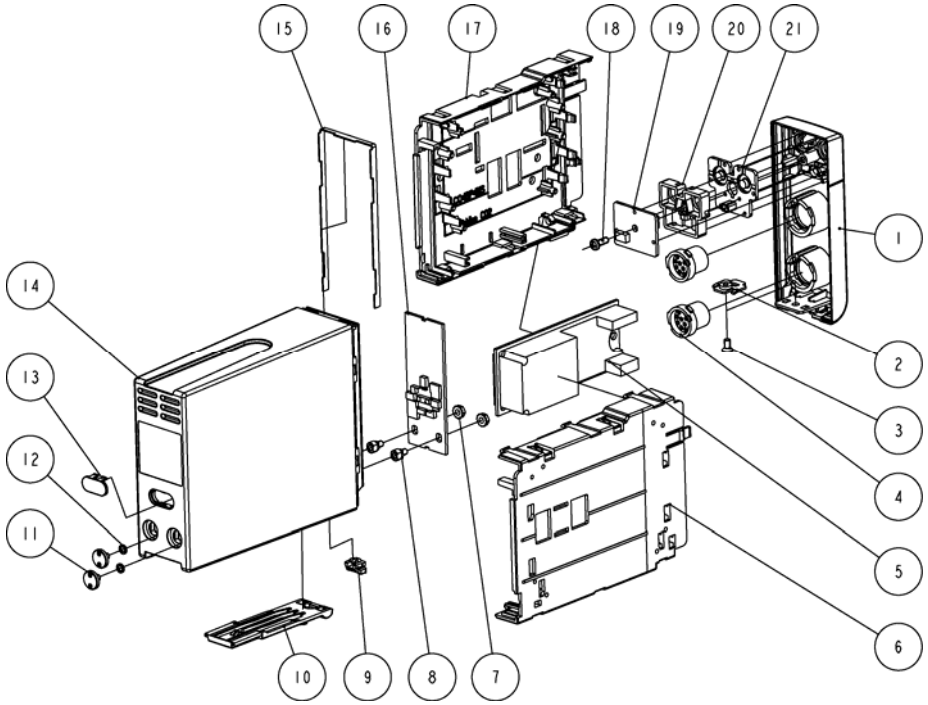


Parts List

SN	P/N	Description	Qty
1	6800-20-50264	Single-slot module front panel（C.O.）	1
2	6800-20-50104	BIS connector	1
3	6800-20-50284	Key pad for single-slot module	1
4	6800-20-50282	Key pad fixture for single-slot module	1
5	6800-30-50114	Button board for Single-slot module	1
6	M04-003105---	Tapping screw PT3×8	1
7	6800-20-50269	Single-slot module inner housing, left side	1
8	6800-30-50092	Isolating power board	1
9	6800-30-50097	Module infrared communication backboard	1
10	6800-20-50286	Locking device	1
11	6800-20-50338	Waterproof seal 01	1
12	6800-20-50268	Single-slot module rear housing	1
13	6800-20-50279	Infrared light filter	1
14	6800-20-50293	Screw	2
15	M04-000104---	Spring washer	2
16	6800-20-50278	Snap plate	1
17	6800-20-50292	Fixer	2
18	M04-005005---	Crosshead screw M3×6	1
19	6800-20-50394	Snap close	1
20	M04-011002---	M3 nut with spring washer	2
21	6800-20-50270	Single-slot module inner housing, right side	1

6.6.7 IBP Module

Exploded View



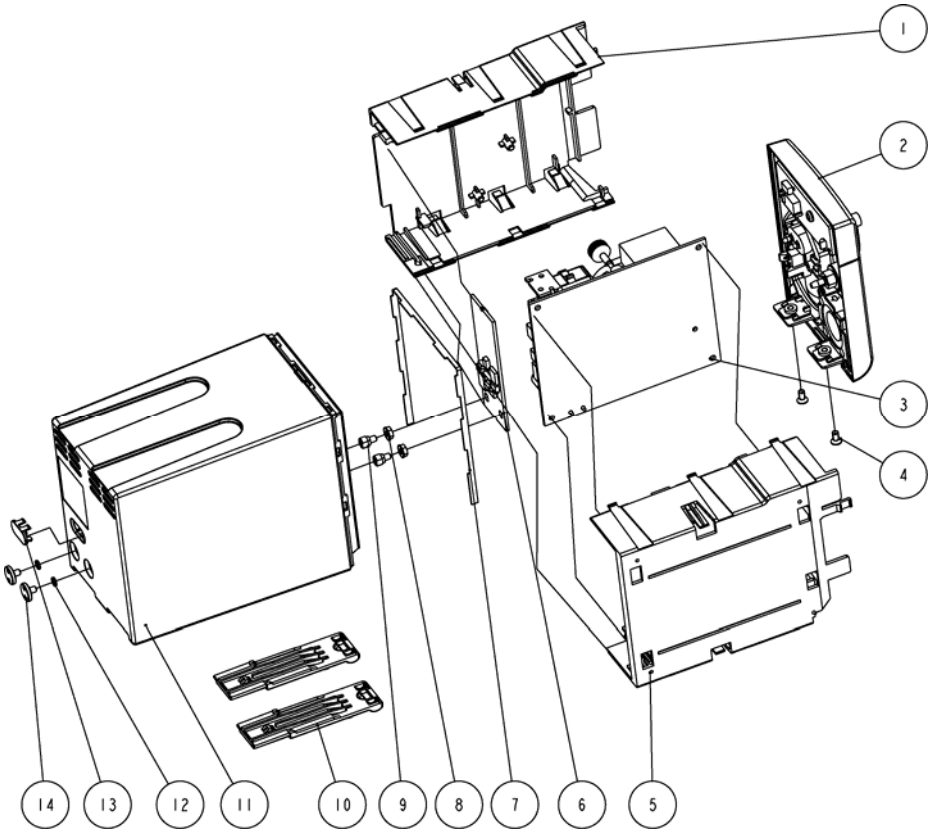
Parts List

SN	P/N	Description	Qty
1	6800-20-50265	Single-slot module front panel（IBP）	1
2	6800-20-50286	Locking device	1
3	M04-005005---	Crosshead screw M3×6	1
4	6800-20-50100	IBP connector	2
5	M03a-30-26058	IBP board	1
6	6800-20-50269	Single-slot module inner housing, left side	1
7	M04-011002---	M3 nut with spring washer	2
8	6800-20-50292	Fixer	2
9	6800-20-50394	Snap close	1
10	6800-20-50278	Snap plate	1
11	6800-20-50293	Screw	2
12	M04-000104---	Spring washer	2
13	6800-20-50279	Infrared light filter	1

14	6800-20-50268	Single-slot module rear housing	1
15	6800-20-50338	Waterproof seal 01	1
16	6800-30-50097	Module infrared communication backboard	1
17	6800-20-50270	Single-slot module inner housing, right side	1
18	M04-003105---	Tapping screw PT3×8	1
19	6800-30-50114	Button board for Single-slot module	1
20	6800-20-50282	Key pad fixture for single-slot module	1
21	6800-20-50284	Key pad for single-slot module	1

6.6.8 Mindray CO_2 Module

Exploded View

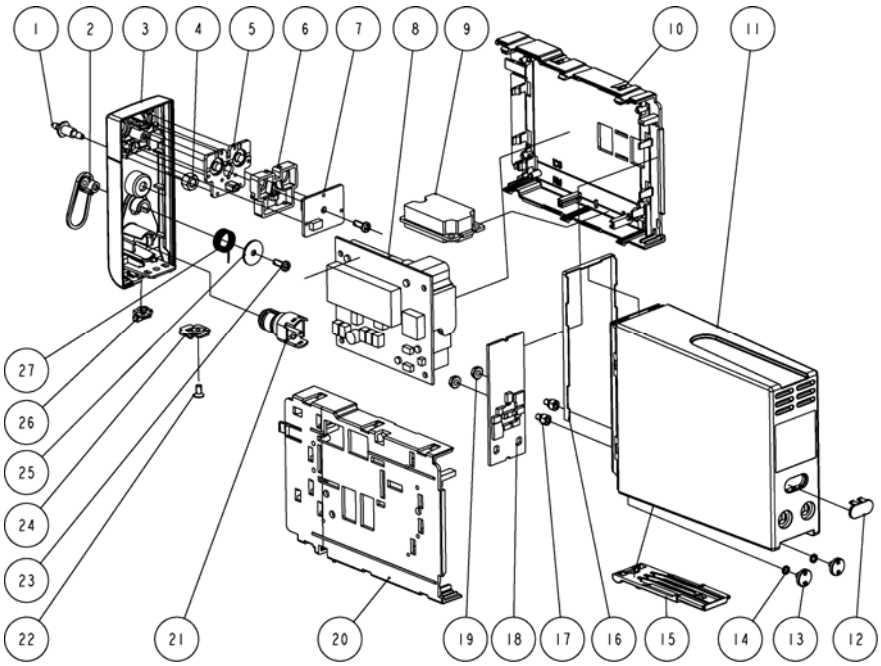


Parts List

SN	P/N	Description	Qty
1	6800-20-50275	2-slot module inner housing, right side	1
2	6800-30-50538	Mindray CO_2 front panel assembly	1
3	M02A-30-25907	CO_2 module main unit	1
4	M04-005005---	Crosshead screw M3×6	2
5	6800-20-50274	2-slot module inner housing, left side	1
6	6800-30-50097	Module infrared communication backboard	1
7	6800-20-50339	Waterproof seal 02	1
8	M04-011002---	M3 nut with spring washer	2
9	6800-20-50292	Fixer	2
10	6800-20-50278	Snap plate	2
11	6800-20-50273	2-slot module rear housing	1
12	M04-000104---	Spring washer	2
13	6800-20-50279	Infrared light filter	1
14	6800-20-50293	Screw	2

6.6.9 Oridion CO2 Module

Exploded View



Parts List

SN	P/N	Description	Qty
1	6200-20-11614	Outlet	1
2	9201-20-35914	Microstream CO2 connector cover	1
3	6800-20-50267	Single-slot module front panel（microstream CO2）	1
4	M04-000501---	Stainless steel nut	1
5	6800-20-50284	Key pad for single-slot module	1
6	6800-20-50282	Key pad fixture for single-slot module	1
7	6800-30-50114	Button board for Single-slot module	1
8	0010-10-42559	Microstream CO2 module	1
9	6800-30-50094	Non isolating power board	1
10	6800-20-50269	Single-slot module inner housing, left side	1
11	6800-20-50268	Single-slot module rear housing	1
12	6800-20-50279	Infrared light filter	1
13	6800-20-50293	Screw	2
14	M04-000104---	Spring washer	2
15	6800-20-50278	Snap plate	1
16	6800-20-50338	Waterproof seal 01	1
17	6800-20-50292	Fixer	2
18	6800-30-50097	Module infrared communication backboard	1
19	M04-011002---	M3 nut with spring washer	2
20	6800-20-50270	Single-slot module inner housing, right side	1
21	9201-30-35959	microstream CO2 module connector	1
22	M04-005005---	Crosshead screw M3×6	1
23	M04-003105---	Tapping screw PT3×8	2
24	6800-20-50286	Locking device	1
25	9201-20-36010	Torsion spring washer	1
26	6800-20-50394	Snap close	1
27	9201-20-35961	Torsion spring for microstream CO2 connector	1

6.7 Replaceable Parts

To replace the parts, please refer to *5 Repair* and Disassembly and the exploded views above.

NOTE

- **Here we list most replaceable parts. If you need more parts, please contact our Customer Service Department.**

6.7.1 Main Unit

P/N	Description	Qty
Front housing assembly		
0000-10-11020	Backlight board	1
0000-10-42633	LCD	1
6800-30-50082	Touchscreen control board	1
6802-30-66810	Button board	1
6802-30-66682	Alarm LED board	1
6800-30-50520	Encoder assembly	1
6802-30-66680	Power switch & LED board	1
6802-20-66673	Cable connecting the inverter and the button board	1
6802-20-66650	Flat cable connecting the LCD and the mother board	1
6802-20-66670	Cable connecting the alarm LED board and the button board	1
6802-20-66671	Cable connecting the power switch & LED board and button board	1
6802-20-66672	Cable between the touchscreen control board and the button board	1
Main unit		
6006-20-39435	Recorder cover	1
6802-20-66665	Cable connecting the recorder and the mother board	1
6802-20-66666	Cable connecting the CF card and the mother board	1
6802-20-66684	Cable connecting the button board and the mother board	1
6802-20-66712-51	Interface board cover	1

6802-20-66717	Main support	1
6802-20-66718	Recorder fixing plate	1
6802-30-66763	Battery compartment assembly	1
6802-30-66653	Battery interface board	1
6802-20-66799	Cable connecting the Integral module rack and the mother board	1
6802-30-66767	Main board assembly	1
6802-30-66769	Interface board assembly	1
6802-30-66771	CF card assembly	1
6802-30-66768	Fan assembly	1
6802-20-66668	Speaker and cables	1
TR6F-30-67306	TR6F recorder	1
6802-30-66770	Power module assembly	1
6802-30-66651	Power board	1
6800-30-50073	MPM module rack communication board	1
6800-30-50075	NiosII module	1
6802-20-66669	Cable connecting the main unit and the infrared communication board	1
6802-30-66676	3-slot module rack communication board	1
6800-20-50198-51	Key pad	1
6802-30-66766	Rear housing assembly	1
6800-20-50672	Cable connecting the main board and the DIV interface board	1
6800-20-50673	Cable connecting the main board and the USB_Hub board	1
6802-20-66664	Cable connecting the DVI interface board and the mother board	1
6802-20-66675	Cable connecting USB_Hub board and the mother board	1
6802-30-66659	USB_Hub board	1
6802-30-66657	DVI interface board	1

6.7.2 SMR

P/N	Description	Qty
6800-30-50075	NiosII module	1
6800-30-50078	SMR communication board	1
6800-30-50080	SMR interface board	1
6800-30-50667	SMR indicating lamp assembly	1
6800-20-50249-51	SMR inside assembly	1
6800-20-50250-51	SMR rear housing	1
6800-20-50251	SMR handle	1
6800-20-50319	Cable connecting the SMR and the main unit	
6800-21-50167	SMR indicating lamp cable	

6.7.3 Parameter Modules

P/N	description	Qty
6800-30-50486	BIS Module	1
6800-30-50488	RM module	1
6800-30-50487	CAPNOSTAT CO_2 module	1
6800-30-50558	ORIDION CO_2 module	1
6800-30-50500	Mindray sidestream CO_2 module	1
6800-30-50491	ICG module	1
6800-30-50501	AG module (with O_2/BIS)	1
6800-30-50502	AG module (with O_2)	1
6800-30-50503	AG module (without O_2/BIS)	1
6800-30-50504	AG module (without O_2)	1
6800-30-50505	Manual AG module (with O_2/BIS)	1
6800-30-50506	Manual AG module (with O_2)	1
6800-30-50507	Manual AG module (without O_2/BIS)	1
6800-30-50508	Manual AG module (without O_2)	1
6800-30-50484	C.O. module	1
6800-30-50485	IBP module	1
6800-30-50495	MPM1 module(Mindray SpO_2, 3/5 lead)	1

6800-30-50564	MPM2 module(Masimo SpO_2, 3/5-lead)	1
6800-30-50566	MPM3 module(Nellcor SpO_2, 3/5-lead)	1
6800-30-50492	MPM4 module(Mindray SpO_2, 12-lead)	1
6800-30-50560	MPM5 module(Masimo SpO_2, 12-lead)	1
6800-30-50562	MPM6 module(Nellcor SpO_2, 12-lead)	1
6800-30-50128	Mindray SpO_2 flexible cable kit	
6800-30-50132	Nellcor SpO_2 flexible cable kit	
6800-30-50130	Masimo SpO_2 flexible cable kit	
6800-20-50662	Air pump cable	
6800-20-50663	Fast-release valve cable	
6800-20-50664	Slow-release valve cable	
6800-20-50674	Cable from ICG module to infrared communication board	
6800-20-50683	Mindray CO_2 infrared communication cable	
6800-20-50306	AG module cable	
6800-20-50309	ICG module communication cable	
6800-21-50310	BIS interface cable	
6800-21-50311	CO interface cable	
6800-21-50312	IBP interface cable	
6800-21-50313	Mainstream CO_2 interface cable	
6800-20-50315	ICG power cord	
6800-20-50316	RM infrared detection board cable	
6800-20-50160	Module button board cable	